

Not Just *for* Show

The Archaeology of Beads,
Beadwork, & Personal Ornaments



EDITED BY

Daniella E. Bar-Yosef Mayer, Clive Bonsall & Alice M. Choyke

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AND PERSONAL ORNAMENTS

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DANIELLA E. BAR-YOSEF MAYER,
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Front cover and spine: Selection of beads from Ypenburg (B.Grishaver).
Back cover: Tear-shaped bone pendants, Hayonim Cave (D. Shaham).

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Introduction: The Archaeology of Beads, Beadwork and Personal Ornaments

Alice M. Choyke and Daniella E. Bar-Yosef Mayer

Beads are commonly defined as being small ornaments perforated through their centers and small enough to be worn on the body. Beads sewn on clothing, parts of composite body decoration from anklets, to bracelets, to girdles, to necklaces and to headbands may be identical or mixed in their size, shape and raw material (Dubin 2009). Beads can be strung in a series on a thread, sewn individually onto clothing, or traded as separate objects that can be counted. They can be dismantled from garments and body ornaments and shared between individuals or given from the living to the dead as part of burial ritual. Pendants are a type of bead that is perforated at one or both ends rather than symmetrically through the middle (Kenoyer 1991). They also can be part of a series of similar objects strung together on a filament of sorts or one of a kind, meant to be accentuated in a special way.

For anyone seriously studying beads, especially with the archaeological material, there is a frustration that most papers dealing with all their various manifestations tend to be scattered in isolated articles. This disarticulated publication record makes it particularly hard to see past the huge diversity of beads and bead use throughout human history. It becomes almost impossible to see patterning of any sort in the way humankind treated with this kind of ornamentation during its long history down to the present day. Theoretical modelling for tackling bead studies becomes extremely difficult and methodologies continue to be invented and re-invented. Consensus is virtually non-existent because of this lack of any sort of serious academic forum, at least within the world of archaeology. This volume of collected articles is intended to bring together specialists from diverse backgrounds and intellectual approaches, working on geographically separated bead material from the deep past as well as more

historic material. The volume is intended to continue and reinforce a serious dialogue between practitioners. The approaches found here are all different but the intent is remarkably uniform. The authors all strive to understand the social forces at work behind the technical strategies, utilization and re-utilization of ornamentation in their particular part of the world and time period.

Beadwork in all its many and diverse manifestations, is a craft involving the creation of planar decoration on a flexible surface such as hide or textile clothing or bands from uniting many beads, often of identical size but also frequently of varying size and shape (Hector 2005). These beads can be sewn, twined, plaited, woven, netted into or glued onto the foundation surface. Designs are created through size, color and texture and the methods used to bring them together. Juxtapositions of beads from particular raw materials may embody their own meanings.

Beads, beadwork and other kinds of personal ornaments (henceforth beads) are among the earliest known symbolic expressions of modern humans and represent an important tool for identification of thinking and cognition in archaeological sciences. Over the past decade, it has become clear that beads first appear within the material culture “package” of early modern humans as early as 100,000 years ago (e.g. Bar-Yosef Mayer 2005; Vanhaeren et al. 2006).

Fowler (2004: 40, 75) has pointed out that the fractal nature of beads, whether in beadwork patterns or in necklaces, other dress ornaments or sewn on clothing, means they can be assembled and reassembled, divided, shared and merged to create and embody a variety of social relationships between individuals in different social contexts.

The ability to think in an abstract manner tells us about the development of modern human cognitive processes

connected to social complexity and, perhaps, the intensity of human-to-human interaction in emerging and developing social groups. Through their raw materials, color, size and shape, body ornaments can signal identity between groups or social status and rank within a group (e.g. Kuhn 2014; Malafouris 2003). Beads are meant to be seen, heard, touched, divided and shared. They send signals directed at a particular audience who are capable of interpreting the meaning correctly because they share similar social traditions. By the Upper Paleolithic, when modern humans spread throughout the Old World, such finds appear regularly on archaeological sites although it has only been recently that their study has intensified. The Magdalenian hunter-gatherers of the Paris Basin were shown by Peschaux et al. (Ch. 3) to produce beads during the “off-season” of hunting. This is the first time it has been demonstrated that there were some populations for whom bead production was a seasonal activity. Beads become increasingly more numerous and more complex in number, variety and technique of production with the onset of agriculture, and even more elaborate within urban societies (Wright and Garrard 2003).

A unique study in this volume by Shaham and Belfer-Cohen represents a relatively new field of archaeological study, sound. They propose that Natufian bone pendants were in fact worn around the hips to provide a rhythmic sound during the dance (Ch. 7). Beads can have a decorative as well as an amuletic function representing a dialogue of sorts between the wearer and supernatural forces (Choyke 2010). They are entangled in a web of individual desires and social prerogatives.

Beads and other forms of personal adornment were made from a wide array of raw materials. These include materials of biological origin such as mollusk shell, ostrich egg shell, ivory, bone, tooth, antler, horn, feathers, wood and seeds, stones and minerals in various colors and with different physical properties such as apatite, malachite, turquoise, ocher, basalt, obsidian, limestone, lapis lazuli and carnelian, and composite materials that require more human intervention to produce, including ceramics, various metals, glazed enstatite, faience and glass (Bar-Yosef Mayer 2014). Mueller-Epstein discusses a wide array of beads made from different materials among Great Basin hunter-gatherers that were used in life-cycle events, health treatments, gaming, arbitration, economic currency and adornment (Ch. 6), showing once again that choice of raw materials may embody more than simple decorative preference.

Difficulties in collecting beads in their original positions during excavation have often meant that this kind of data is lost to researchers who receive these finds in the laboratory. Likewise, beadwork rarely survives intact in archaeological settings for taphonomic reasons; although where it does,

it provides clearer insight into the society inhabited by its makers. Bos had the opportunity to study a well-preserved tunic with elaborate beadwork worn by Tutankhamun. Close study of the beadwork revealed manipulation by craftspeople just prior to the pharaoh’s interment (Ch. 9) creating a more dynamic picture of the burial ritual surrounding the young pharaoh.

Wearing particular ornaments binds us in groups and divides us as individuals. Beads and ornaments are about different kinds of social identity as well as personal preference and enhancement of physical appearance. The limitations and possibilities of these objects are manifold and so each period and settlement needs to be considered on its own merit before more sweeping generalizations can be made about the meaning of beads and ornament production and use within a region or over long swathes of time. Apparent parallelism between forms does not necessarily represent the same kind of ideas. Identical forms can be transmitted but understood and used in very different ways. The value of individual bead types can be acknowledged over large geographical areas even while their local symbolic interpretations and use in individual identity formation vary.

At the same time, because of their fractal nature, beads especially represent an excellent medium for construction of value, trade and exchange within economic networks discussed in several papers in this volume. Spatz studied Neolithic shells in the Levant that were traded from either the Mediterranean or the Red Sea, some of which arrived at inland settlements as raw materials while others came to the settlement as finished beads (Ch. 5). Beads produced in one area from unique raw materials can be ascribed an accepted equivalency commodity value over vast different areas. The earliest case presented in this volume relates to 35,000-year-old shell beads from Australia that were studied by Balme and O’Connor. Those were taken inland from a distance of 150–500 km and were used in both secular and ceremonial contexts (Ch. 2). Another extraordinary example of long-distance and short-distance movement of shell beads is the use of Mediterranean gastropods found in the Mesolithic Danube gorges. Because they were introduced into the sites from large distances, Cristiani and Borić propose that the long-distance beads refer to origin myths, while the beads made from local cyprinid pharyngeal teeth and freshwater snails resonate with personhood (Ch. 4). In fact, distance and rarity as well as personal associations can also enhance the value of ornaments that on face value may appear simply decorative (e.g. Sciama 1998).

The history of bead and ornament study is filled with descriptive generalizations based on color and morphology. Beads, beadwork and pendants are visually seductive. They not only had an effect on the people who used them, but on the archaeologists who discovered them. This led to simple

description of their raw material, color and morphology and sometimes context (mortuary, elite construction, etc.); however, rarely were attempts made to study them more deeply. Recently, with advances in microscopic studies for manufacture and use-wear analysis, digital technology, chemical analyses and closer attention to raw materials, the social plasticity of this kind of object has begun to reveal itself in assemblages from our distant and not-so-distant past. Again, new technologies enable us to look more deeply at the wear on beads and other ornaments, which gives clues to differences in their life histories. Van Gijn, studied beads' biographies under high magnification and was able to show changes in their wear patterns over time. Middle Neolithic Dutch beads were treated on a personal level, whereas the later Funnel Beaker specimens were reworked to express collective identity (Ch. 8). Now, with improved digital photography in the field and lab and recognition that sequence may be important, ancient technology is revealed. Schneider and Hager use the recently developed technology of Reflectance Transformation Imaging to show that soapstone disk beads were produced both by craft specialists and by non-specialists in the prehistoric Napa Valley in northern California (Ch. 11), while Velázquez-Castro et al. used scanning electron microscopy to study the carving technology of prestige goods in Formative Period Mexico (Ch. 10).

Reproduction experiments are another tool to better understand past technologies. This approach was used by Campbell to demonstrate how very thin (1–3 mm long) tusk shell beads were produced in the Epipaleolithic of the Levant (Ch. 13). Gurova and Bonsall were able to differentiate between the production of soft stone beads (up to 5 on the Mohs scale) in the Neolithic of the Balkans, and the production of beads from harder materials (above 5.5 on the Mohs scale). The former could have been produced by non-specialists, while the latter required specialist expertise (Ch. 12). The interpretative devil often really does lie in the detail when it comes to the study of archaeological beads.

The original idea for a session at the SAA came from discussions between Daniella Bar-Yosef Mayer and Alice Choyke about how we could promote the study of beads and other body ornaments in archaeology. Following the session, we added papers from scholars to round off the three areas of study we thought should be promoted and expanded: socio-cultural reflections; audio and visual social cues; and methodological approaches and experimentation. These categories represent the three sections of the volume. However, most papers in this volume have a multidisciplinary approach incorporating both the technological aspects of bead or ornament manufacture as well as their broader social, cognitive and economic implications.

Thus, the papers in this volume cover many thousands of years of human prehistory. They extend geographically from North and Central America to Australia, the Near East, Egypt and Europe. This was no accident. The editors have tried to present a wide variety of case studies from different times, places and approaches to a subject that is far more about the way people relate and associate with each other than it was ever about simple decoration for decoration's sake. Traditional descriptions of beads and ornaments in most archaeological reports only scratch the surface of what this class of artifact can tell archaeologists about how people interacted with each other through time and in particular locations. This volume is a first step in the creation of an academic forum comprised of scholars interested in exploring the way beads have been used, not only to please the eye but as material expressions of social relations.

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Part 1

Socio-Cultural Reflections

Traditions and Change in Scaphopod Shell Beads in Northern Australia from the Pleistocene to the Recent Past

Jane Balme and Sue O'Connor

Abstract: *Shell beads were made in Australia from about 35,000 years ago. They include perforated marine gastropods and intentionally fractured segments of scaphopods. While some of the oldest Australian examples are in archaeological sites that were close to the Pleistocene coastline, in the southern Kimberley of northern Australia, beads are found primarily in early Holocene contexts and in sites that were more than 500 km from the coast at the time of their deposition. This suggests that they were either traded or exchanged “down the line.” Historic photos and ethnographic evidence reveal that in the recent past Indigenous men, women and children in coastal locations wore such beads, whereas in central Australia they took on powerful properties and were used in ceremonial contexts with gender and age restricted use. One of the characteristics of marine shell ornaments in northern Australia is their bright, white or lustrous appearance that seems to have been intrinsic to their selection as body adornments. Distributions of shell beads across time and space in Australia can be interpreted as being related to changes in access to resources and social value which has implications for the interpretation of archaeological beads elsewhere.*

Introduction

Beads and pendants made from organic materials including seeds, grass stems, bone, teeth and shells were and remain a common form of body decoration in Australian Aboriginal societies. Those found in pre-Macassan and European archaeological contexts are made of the most durable materials, bone, teeth and shells and, of these, shell beads have been found in the oldest contexts where they date from at least 35,000 years ago. In mainland Australia, shell beads are confined to the north of the continent and archaeological finds are restricted to only two shell varieties – *Conus* and scaphopod.

In the southern Kimberley, beads are exclusively made from segments of scaphopod and are found primarily in early Holocene contexts of inland archaeological sites. As these sites were between 200 and 500 km from the coast at the time of the beads' deposition, it is likely that the beads were traded or exchanged “down the line.” Historic photos and ethnographic evidence reveal that in

the recent past Indigenous people in coastal locations wore scaphopod as strands and as hair adornments. There is no record of their use in the inland regions of the Kimberley at European settlement, perhaps suggesting that they were used differently away from the coast, or that there was a break in traditional use. Here, we discuss some of the features of the beads, the evidence for their location and antiquity from five Kimberley sites and speculate that their uneven temporal and geographic distribution in the archaeological record may be related to their changing social value and meaning with increasing distance from their coastal source.

In this paper, rather than the commonly used genus name *Dentalium*, we use the class term scaphopod for all tusk shells. As none of the fragments include the posterior part of the shell, it is not possible to further classify the shells beyond saying that they could represent eight species within the families Dentaliidae, Fustiariidae and Laevidentaliidae (G. Kendrick, pers. comm.).

Chronology and Distribution of Shell Beads and other Marine Shell Ornaments and Value Goods from Archaeological Sites in Australia

Shell beads have only been found in two areas in Australia, northwest Australia and Tasmania, an island to the south of the mainland that was effectively severed from mainland contact by the rough waters associated with the rising of sea levels about 12,000 years ago. The oldest Tasmanian shell beads so far recovered are associated with a burial at the site of West Point and are dated to between $1,800 \pm 80$ and $1,330 \pm 80$ BP (Jones 1967:363).

The oldest shell beads found in Australia date to earlier than 35,000 cal BP (Morse 1993a) and derive from sediments within a rock shelter on the Pilbara coastline known as Mandu Mandu Creek (Fig. 2.1). There are 22 beads, all made on *Conus* sp. (provisionally ascribed to *C. doreensis*) and all, except the smallest one, have been modified to form

beads (Balme and Morse 2006:803; Morse 1993b:880). Six of the shells have been pierced and hollowed out while the remaining beads have been made from a section of spire of individual shells (Balme and Morse 2006:803). There is evidence of string wear and the large number and even size distribution of the beads in a single excavation unit combine to suggest that they once formed a single strand (Fig. 2.2).

Conus doreensis typically lives in shallow waters on reef platforms and in sand under rocks, environments consistent with the predominantly reefed shoreline of the area (Balme and Morse 2006:882). The shells used to make the Mandu Mandu beads were probably acquired locally as the shelter is located less than a kilometer from the coastline today and where, because of the steeply shelved offshore profile, it would never have been more than 10 km from the Pleistocene coastline, even at the low stand of the Last Glacial Maximum.

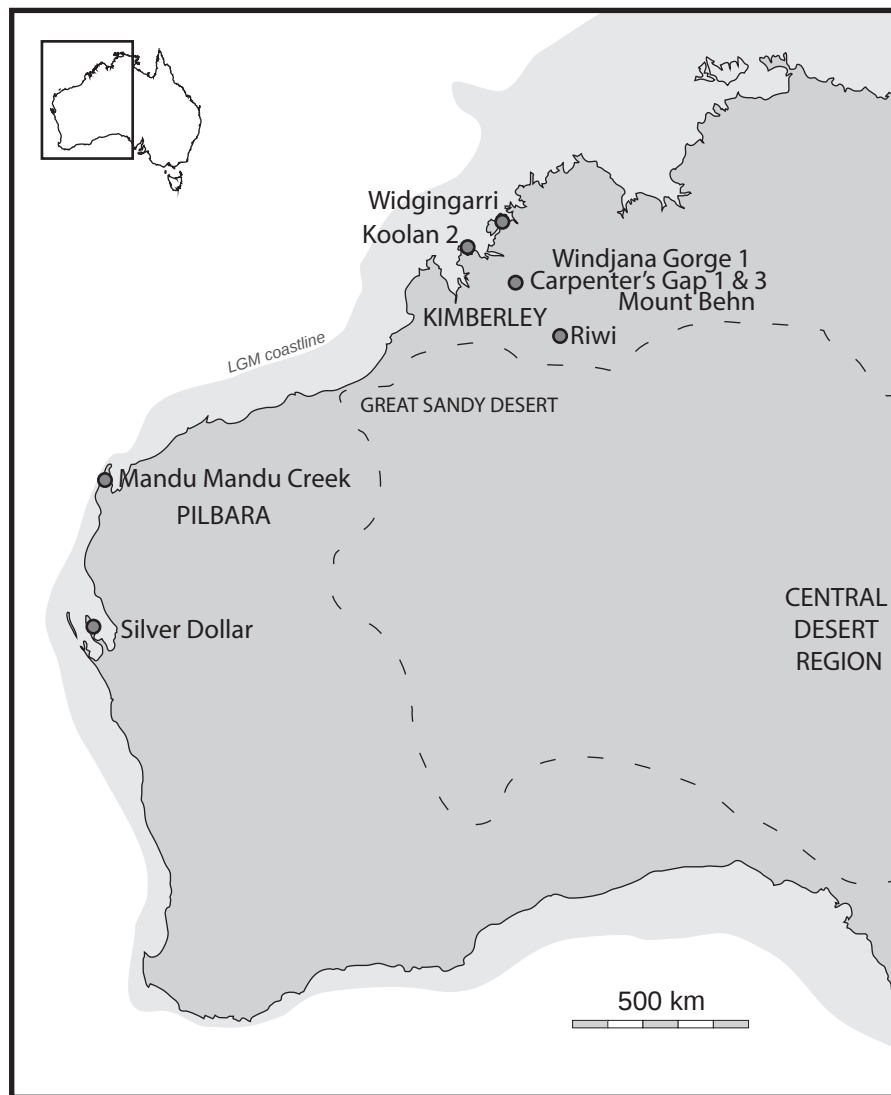


Figure 2.1 Locations of sites and places mentioned in the text (illustration by Dorcas Vannieuwenhuyse).

While there are other shell fragments from species traditionally used to make jewelry rather than as dietary items at Mandu Mandu, these are somewhat younger. Three more fragments of *Conus* sp., one of which shows signs of modification, were recovered from deposits estimated to be about 24,000 cal BP (Morse 1993a:882) and fragments of pearl oyster shells, which were commonly used as personal ornaments in the recent past (see Akerman and Stanton 1994), were found in Pleistocene deposits (Morse 1993b:145–146).

Fragments of scaphopods were also recovered from Pleistocene deposits at Mandu Mandu in sediments dating to between ca. 26,000 and 22,000 cal BP as well as in Holocene levels (Morse 1993b:145–146) including the uppermost excavation unit, which is less than 400 years old, (Morse 1989:86). Interestingly, these beads are isolated occurrences in the Pilbara region as no examples of shell beads have been reported from other coastal sites there, although pierced baler shell (*Melos* sp.) fragments, interpreted as pendants, have been found in late Holocene coastal shell middens in the area (Przywolsnik 2003).

Ten scaphopod fragments interpreted as beads and recovered from deposits dated to ca. 34,000 cal BP have been previously reported from Riwi, a limestone cave site in the southern Kimberley that is currently located some 300 km from the coast (Balme 2000; Balme and Morse 2006). Scaphopod beads have also been reported from Carpenter's Gap 1 rock shelter to the west of Riwi in Windjana Gorge National Park (O'Connor 1995:59); however, these were all from Holocene contexts. Recent excavations in the same limestone system as Riwi have shown that inland movement of scaphopod beads was relatively common in the southern Kimberley and that the use of shell beads has a long history in this region.

Scaphopod Beads from Inland Kimberley Sites

The caves and rock shelters described here are all formed in the extensive Devonian limestone reef complex of the southern Kimberley of Western Australia (Playford et al. 2009). The region today has a tropical monsoon climate that is warm and dry during the winter months and hot and wet in the summer. Its southern border abuts the very hot and dry Great Sandy Desert. The alkaline and relatively dry environments of the caves and shelters in the reef complex have resulted in remarkable preservation of organic material within the sites.

In addition to Riwi, beads have been recovered from four shelters: Carpenter's Gap 1 and 3, Windjana Gorge 1, and Mt Behn (Fig. 2.1). All sites were used into historic times and were known to local Indigenous people. The evidence for Riwi and Carpenter's Gap 1 suggests that human occupation began ca. 47,000 cal BP, although a recent program of sample collection for Optically Stimulated

Luminescence (OSL) dating at Riwi may extend this age estimate. Currently, the earliest evidence for occupation at Carpenter's Gap 3 is ca. 34,000 cal BP, at Windjana Gorge ca. 13,000 cal BP and at Mt Behn ca. 3,000 cal BP.

The beads from Riwi have been described in some detail in Balme and Morse (2006:806). In brief, they vary between 5.2–17.55 mm with a mean of 12.5 mm. Most are longer than 10 mm. The fragments used are from the anterior (non-tapering) end of the shell. A residue, visible to the naked eye, is present within the sinuous grooves and on rough surface areas of the shells, notably the broken ends. Under a stereomicroscope at 50× magnification, this residue is dark red/black (Fig. 2.3a) and could be ocher or ocher mixed with some binding substance.

A total of 37 beads have been recovered from the other four sites, 15 from Carpenter's Gap 1, five from Carpenter's Gap 3, two from Windjana Gorge 1 and 15 from Mt Behn. Like the Riwi beads these beads vary in length; the Carpenter's Gap 1 beads range from 2.65 to 22.10 mm, the Carpenter's Gap 3 beads from 9.13 to 23.75 mm, those from Windjana Gorge 1 from 14.18 to 18.69 mm and at Mt Behn from 4.2 to 12.6 mm. There are a variety of signs indicating the modification and use of these beads including polish, small fibers on the inside edge of the bead, wear on the edge of the bead and residue suggesting applications of color either on the bead itself or through rubbing against a painted body. Six beads have a deep undulation on at least one of their ends that are interpreted as the result of rubbing against stringing thread (e.g. Fig. 2.3b).

The fractured ends on the beads from all sites display a variety of morphologies including some with cut notches (Fig. 2.3a), straight (Fig. 2.3c) and some of the broken ends having uneven surfaces (Fig. 2.3d) in addition to edge polish.

Vanhaeren and d'Errico (2001) showed that breaking scaphopod shell by snapping and by sawing produced different characteristics on the fractured end of the shell. Snapping the shell produces sharp and perpendicular ends whereas sawing produces ends with two facets – one of which is oblique to the shell axis and the other is perpendicular (Vanhaeren and d'Errico 2001:216). Sawing also leaves marks resulting from the to-and-fro movement of the cutting edge. Moya Smith, of the Western Australian Museum, observed another method of creating beads from scaphopods on the coastal Kimberley in 1993. These beads are still made today by Bardi women, and Audaby Jack, the woman observed by Smith, made the beads by placing an intact shell on a stone anvil and then applying pressure to the shell with the back of a knife which she then snapped along the knife edge (Fig. 2.4). The shells were considered to be too delicate to be directly cut with the knife. Kim Akerman also observed this method in the same area during the 1970s (Kim Akerman, pers. comm. 2013). It produces a variety of morphologies on the fractured end, including perpendicular straight edges, oblique straight edges and

edges with small chips presumably from the pressure of the knife. The combinations of fractured ends of the southern Kimberley beads indicate that they may have been produced by a combination of snapping and pressure breaking, as in the modern Bardi method.

In morphology, the beads are not unlike those in Australian museum collections collected in the nineteenth and early twentieth centuries. Figure 2.5 shows one such strand collected in 1942 from Wyndam in the northern Kimberley. Most of these were strung on string made from a native plant fiber although later strings are often made from



Figure 2.2 Mandu Mandu shell beads *Conus* sp. (photo by Doug Elford, Western Australian Museum).

material brought by Europeans, such as wool. The example in Figure 2.5 has ochre over the surface, which is thickest in the cracks, much like the example from Riwi shown in Figure 2.3a. This suggests some very long-lived practices.

Chronology of the Kimberley Beads

The chronology for the beads found in these sites was determined by a combination of interpretation of their association with radiocarbon dates from other organic materials and from direct AMS dates that were attempted on samples of the beads.

All ten of the Riwi beads came from the northeast quadrant of a one-meter test trench and from sediments with two similar charcoal radiocarbon dates calibrating to between about 30,700 and 33,500 years ago. Only one bead fragment was selected for direct dating. This returned an early Holocene date of between 7,644 and 7,459 cal BP (Wk36313R, $p = .95$). Unfortunately, the aragonite shell has been recrystallized as calcite. There is no discoloration of the bead or the ochre covering part of the bead and there are no obvious indications of burning or other visible evidence of alteration to the structure of the shell. In the absence of any indications of burning, the source of this re-crystallization can only derive from groundwater within the deposits. This



Figure 2.3 Scaphopod beads from southern Kimberley sites: a. Riwi bead showing red residue and cut notches; b. Mt Behn bead showing wear from stringing thread; c. Mt Behn bead showing straight fractured end; and d. Carpenter's Gap 3 bead showing uneven fractured ends (photos by Jane Balme and Rose Whitau).

leaves some uncertainty surrounding this date that we hope to resolve with fine resolution excavation and associated OSL and radiocarbon dates in future.

Carpenter's Gap 1 is a spacious rock shelter located along the northern margin of the Napier Range and about 25 m above the surrounding plain. Today the site is a minimum distance of 150 km from the coastline. A five-meter trench was excavated in two-centimeter excavation units at Carpenter's Gap 1 between 1992 and 1993 (McConnell and O'Connor 1999; O'Connor 1995). Scaphopod beads were encountered in only two of the five excavation squares. Although the beads have not been directly dated, they all derive from within or above excavation units dated to ca. 4,000 cal BP.

Direct dating of beads from Carpenter's Gap 3, Windjana Gorge 1 and Mt Behn has produced only Holocene ages

(Table 2.1). The two dated Carpenter's Gap 3 beads are mid-Holocene. Of the remaining three beads, one was recovered from sediments associated with a radiocarbon date of 6,436–6,298 cal BP (SANU-30229, $p = .95$), one was recovered from between these dated sediments and sediments dated to 11,590–10,876 cal BP (SANU-29413, $p = .95$) and the third is from sediments that are undated but are probably Holocene in age.

Mt Behn is a richly decorated rock shelter in an isolated limestone outcrop a few km to the east of CG1. The area of the deposit sampled during the 2012 excavation (2×1 m) dates from the late Holocene, although it is possible that a longer sequence may be preserved elsewhere in the site. There is a break in deposition between about 2,000 years ago, and historic times. Seven of the eight beads that have not been directly dated derive from excavation units that are older than 2,000 years and the remaining bead derives from excavation unit 2 on the border of the historic and pre-2,000-year-old material.

The two Windjana Gorge 1 beads are the same age – early Holocene – and derive from sediments at the upper boundary of a discontinuity in the deposition at the site that dates from about 13,000–8,000 years BP. All material above that discontinuity dates to the last 1,500 years.

In summary, apart from the Riwi beads that need further work on the dating, all the beads from the remaining sites date from the early to late Holocene. The one exception is a bead from the Mt Behn site, which has not been directly dated. It lies on the boundary of a break in deposition between late Holocene and historic deposits dating to the last 260 years and could possibly belong to the period just before European settlement of the area that began in the late nineteenth century.



Figure 2.4 Bardi woman, Audaby Jack making scaphopod beads (photo by Moya Smith, Western Australian Museum).

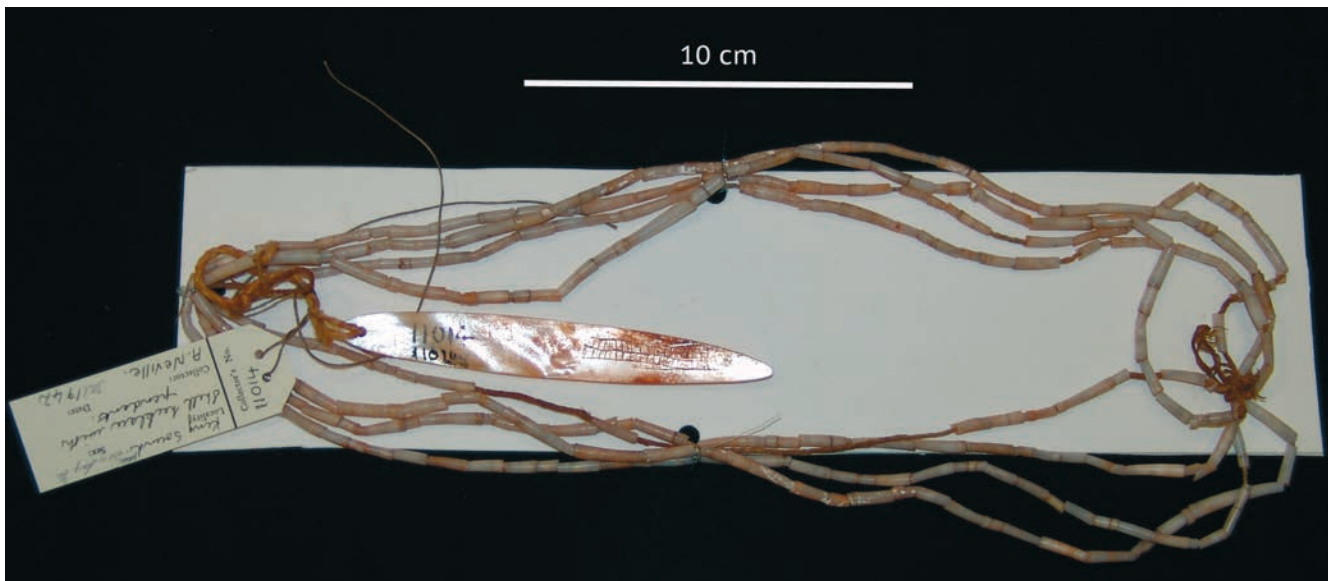


Figure 2.5 Scaphopod bead string with pearl shell pendant collected from the north Kimberley in 1942 (photo by Jane Balme of artifact held in the Western Australian Museum collection).

Table 2.1 Direct AMS dates for scaphopod bead fragments from three sites in the southern Kimberley. All radiocarbon samples were calibrated using Ox Cal 4, with marine shell samples calibrated using the marine curve [Marine13] (Reimer et al. 2013), with a delta R correction of $\Delta R = 54 \pm 37$.

EU	Site	Lab. code S-ANU	Excavation code	Radiocarbon age	Age cal BP 2 sigma 95.4
4	Mt Behn	33026	MB1-1a-4	2740 $\pm$ 35	2602–2270
6	Mt Behn	33027	MB1-1a-6	2505 $\pm$ 35	2273–1958
8	Mt Behn	33029	MB1-1c-8.2	2225 $\pm$ 40	1891–1608
8	Mt Behn	33106	MB1-1c-8.1	2995 $\pm$ 35	2843–2567
9	Mt Behn	33030	MB1-1a-9	3695 $\pm$ 40	3685–3399
10	Mt Behn	33031	MB1-1b-10	3755 $\pm$ 40	3790–3468
11	Mt Behn	33032	MB1-1b-11	3310 $\pm$ 40	3239–2611
12	Mt Behn	33033	MB1-1d-12	5060 $\pm$ 40	5510–5240
16	Windjana Gorge 1	33034	WG1-1a-16	8105 $\pm$ 45	8709–8431
18	Windjana Gorge 1	33035	WG1-1c-18	8100 $\pm$ 45	8698–8426
7	Carpenter's Gap 3	33036	CG3-b-7	5115 $\pm$ 40	5553–5298
10	Carpenter's Gap 3	33037	CG3-b-10	6910 $\pm$ 45	7476–7255

Conclusions from the Review of Australian Shell Beads from Archaeological Deposits

Five points can be made from this review of shell beads from archaeological deposits in Australia. First, they are restricted to the northwest of Australia and Tasmania. This may be in part a factor of preservation or the lack of access to suitable shellfish supply zones in some areas, but archaeological sites in other areas, such as southwest Australia and the Murray Darling system of western New South Wales contain beads made of other materials including bones and teeth (Dortch 1979; Macintosh 1971; Pretty 1977). Within northwestern Australia the beads appear to be confined to the Pilbara and Kimberley regions, as no examples have ever been reported from archaeological contexts in Arnhem Land, or elsewhere in the Northern Territory, despite this region being a focus of archaeological excavation over many decades.

Second, there is clear evidence of species selection for bead use. The northwest coastline is extensive and diverse. It contains rocky platform, mangrove and sandy embayments and has one of the greatest diversities of marine species available in any region of Australia with many Indo-Pacific species. These include cowries, cone shells and large numbers of brightly colored and vivid shells prized by collectors today. It is therefore somewhat surprising that only two shell species have been recovered from archaeological sites as beads: *Conus* and scaphopods. Both would have been readily available in the nearest coastal waters to the sites. *Conus* shells are colorful and patterned and so are very attractive for ornamental purposes but the snails are venomous and would not have been

eaten. Their collection would have therefore only been for ornamental purposes. Scaphopods, while edible, are abundantly available on sandy beaches after storms. They require little modification apart from breaking into sections for beads and are a bright, shiny white.

Third, apart from the early *Conus* shell beads from Mandu Mandu and the Riwi beads whose dating is uncertain, all of the shell beads date from the early Holocene. This is consistent with beads made from other materials in Australia (see Hapgood and Franklin 2008:tab. 3).

Fourth, the distribution of the Kimberley shell beads indicates that they were carried or exchanged down the line over considerable distances in the past. Over 30,000 years ago, at the time the Riwi beads are presumed to have been deposited, sea levels were low and the site would have been at least 500 km from the ocean source of scaphopods. The other Kimberley beads reported here are from sites closer to the coastline and are associated with sea levels similar to those of today. Nevertheless, even today these sites are a good 150 km or so from the nearest coastline (Fig. 2.1).

Finally, the archaeological distribution of beads does not include the areas from which the raw materials are derived. Surprisingly, no scaphopod or other shell beads have been recovered from the many shell middens, cave and rock shelter sites excavated along the Kimberley coastline. It would appear that, while beads were made and used in coastal communities in historic times, if they were similarly used on the coast in prehistory they were treated differently in their discard state and did not end up as part of the archaeological record.

Shell Beads and the Wider Context

The features of shell beads, that is, species selection, uneven distribution, and transportation are frequent observations elsewhere in the world during Paleolithic times. Beads, and shell beads in particular, are a common type of ornament that occur in archaeological sites from ca. 100,000 years ago, with the earliest shell beads being recovered from Skhul Cave and Qafzeh Cave in Israel (Bar-Yosef Mayer 2005; Vanhaeren et al. 2006). Some of these, like the Kimberley beads described here, have ochre stains on them (Bar-Yosef Mayer et al. 2009). Selectivity of shell species used as beads is seen in most sites containing shell beads. For example, White (1992:550) has shown that fewer than a dozen species make up 90 per cent of several hundred known beads from the Aurignacian. Some researchers have found changes in proportions of different species over time (e.g. Taborin 1993 for French Aurignacian and Perigordian) and Stiner et al. (2013) have noted an increasing richness of species used over time at Üçağızlı Cave in Turkey over the Upper Paleolithic and Epi-Paleolithic. *Dentalium* species in particular are more prevalent in the later period, a pattern also noted by Bar-Yosef Mayer (2005) for the Levant. The availability of shell species is obviously one reason for the selection used but, other than that, the reasons for selection are difficult to speculate upon although size and morphology may have played a role (Stiner et al. 2013:393).

The uneven distribution of shell beads in Upper Paleolithic Europe has been documented by Vanhaeren and d'Errico (2006) who noted the absence of shells for use as beads in some sites close to shell sources and their presence in some sites at distance from their sources. White (2007:299) has also pointed out the lack of clear association between raw material abundance and selection of bead-making raw material in the early Upper Paleolithic.

Shell beads in the European Aurignacian are found in sites that are a similar distance inland to those found in the southern Kimberley. Vanhaeren and d'Errico's (2006) review of the distribution of these shell beads report that five shell species, only available on the Mediterranean coast, are found at five sites from the southwest of France that are located more than 300 km from the Mediterranean Sea and three Atlantic shell species are found at five Mediterranean sites. Mediterranean shell beads are also common at sites in Italy and Austria that were at least 300 km inland at the time of their deposition (Vanhaeren and d'Errico 2006:1118).

The appearance of beads has been suggested to have coincided with times when the chances of meeting strangers and the benefits of advertising one's identity is high (Kuhn et al. 2001) and such times would have been higher when population density increased (e.g. Gamble 1999; Kuhn and Stiner 2007; Shennan 2001), but see Sterelny (2011:812) on some of the difficulties with such arguments. Whatever the function of the beads, the distance over which they have been traded or carried supports at least the notion of

inter-group contact, and that these particular species of shell beads had significant social value to the communities living at the sites in which they were recovered. Ethnographic sources from Australia's north demonstrate how these values might change across distance.

Ethnographic Use of Scaphopod Shell for Beads and Worn Paraphernalia

In the Kimberley region, there is ethnographic evidence – in the form of photographs and items in museum collections – that shell beads made from segments of scaphopod shell were worn strung in long strands, sometimes with pearl shell pendants, and as hair decoration, by people in coastal communities. In these coastal settings, they were worn by children as well as adults (e.g. Fig. 2.6) and so it does not appear that there was necessarily any special significance accorded to the beads at their point of origin. However, they were also used in ceremonial contexts on the Kimberley coast. For example, the anthropologist Worms (1938), describes the placement of scaphopod shell necklaces around the neck of male initiates in a coastal initiation ceremony. This use of shell ornaments for both secular and ceremonial use on the Kimberley coast is not restricted to scaphopod beads as ornaments made of baler shell (*Melos* sp.) (Akerman 1973) and pearl shell (*Pinctata* sp.) were also worn in secular life as well as having particular ritual uses in the coastal Kimberley (Akerman and Stanton 1994:22–23).

In coastal Western Australia, as in many other parts of Australia, many different types of marine shells, including baler shell, have been used for a variety of functions including containers, scrapers and spoons (see Przywolnik 2003:16 for a short review). However, it is only these three species – scaphopods, baler shell and pearl shell – that have been recorded in sites far from the coast and dating to pre-European settlement and early European settlement times.

There are good, dated ethnographic records, especially photographs and objects held in museum collections, for the movement of baler and pearl shell from coastal areas, into the desert. Mountford and Harvey (1938), Mulvaney (1969), Akerman (1973) and Akerman (1979) and Akerman and Stanton (1994) have documented the distribution of traded baler, pearl and scaphopod shell. One of the features of these records is the degree to which the shells are curated the further down the line they were traded (Akerman and Stanton 1994; Mountford and Harvey 1938; Mulvaney 1976). For example, Akerman (1973:124) reports that in 1972 he found fragments of baler shell within the environs of a camp at Wiluna and the men told him that these were places where pendants had been chipped and ground down for rain making ceremonies. While Akerman (1973) and Akerman and Stanton (1994) report that baler shell found inland was used for other purposes, the primary purpose for

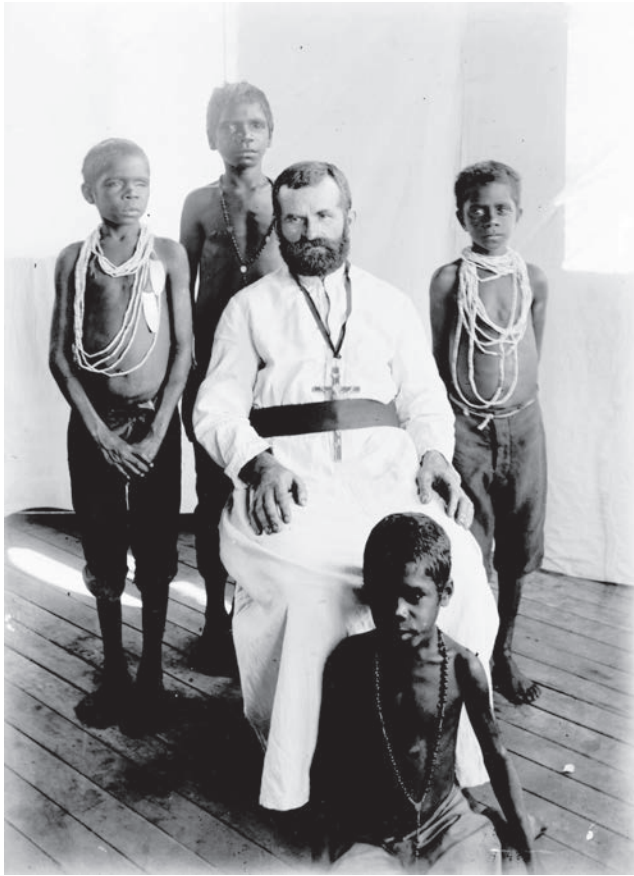


Figure 2.6 Father Rudolph with some young boys at Beagle Bay Mission on the Kimberley coast. Image taken in 1909 by Fr Bischoff (photo courtesy of the Western Australian Museum, Registration number DA Bischoffs 09).

baler and pearl shell in desert regions is as pendants in rain making ceremonies. In these contexts, they are powerful objects. It has been suggested that the further the shells were traded, the more powerful they became. Mountford and Harvey (1938:128–129) for example, describe the use of baler shell for witchcraft and in the male initiation ceremony amongst the Dieri in the desert of northeastern South Australia.

The special power of pearl shell in the different places that it was used has been attributed to the qualities of its shimmering iridescence or brilliance and shininess – a detailed discussion of this is provided in Akerman and Stanton (1994:19–32). On the Kimberley coast these qualities of pearl shell are associated with water, spiritual powers and healing. Brilliance or iridescence is a quality that Morphy (1989:36) believes operates cross-culturally and in Australia is often associated with or imbued with special powers. These intrinsic qualities have similarly been suggested to account for the trade distribution of other kinds of raw material or artifacts within Australia, most notably the large, shiny, white stone blades known as “leilira” blades

(Allen 1997). It is the presence of these prized qualities that probably underlies the selection of scaphopods, baler shell and pearl shell as items of personal adornment and trade over long distances.

Changes in access, transportation and demography affected the speed in which goods were transported so that before the availability of new forms of transport, initially horses, movement of goods might have been slow, as the goods were curated down the line. However, Akerman and Stanton (1994:16) suggest that movement of prestige goods in pre-contact times was also rapid but that access to new forms of transport affected the bulk of material that could be moved at one time. Akerman and Stanton (1994) document the life histories of pearl shell pendants and show that there was a rapid increase in their production and exchange after 1900 perhaps in part because of new methods of transport also because of the development of the pearling industry on the northwest coast from the late nineteenth century. They also suggest (1994:16) that the concentration of people on missions may also have provided opportunity for more ceremonies in which these objects were needed. Thus, while in pre-European contact times pieces of shell used by desert people might have been rare and very small by the time they reached inland places, changes in access and transport meant that the artifacts were less curated during their trade as there was less need to make the artifacts “go further.” Interestingly, these more complex traded objects seem to have, at least sometimes, included scaphopod shells (always abundant on the coast) included in the artifact. For example, in 1976, Akerman (pers. comm.) recorded many pearl shells at Yuendumu, in the Australia’s Central Desert, some of which were fixed as pendants attached to long strands of scaphopod shells. Similar objects are held in the Western Australian museum from Kimberley coastal areas.

Although there is much ethnographic literature on the ceremonial use of baler and pearl shell in non-coastal environments, we found very little for scaphopods. An exception to this is Kim Akerman’s observation (Akerman, pers. comm. 2013) of a necklace of scaphopod shell beads (traded from Lombardina via Broom) strung on fiber string being used at Fitzroy Crossing for ceremonial purposes in 1976. We could find no references to scaphopod use in the area from which they were recovered from our excavations. We did, however, find one reference to their use by Walpiri people in Australia’s central desert. Meggitt (1966) recorded that the Walpiri regarded scaphopods as so dangerous and powerful that they could only be seen by initiated men or men.

While the initiated men are at Yarungganyi they also encounter for the first time the dangerous and powerful landjulgari scaphopod shells. The moon-dreaming man, during his many journeys back and forth between Ngangga (Mount Leichhardt), Yanarildji (Cockatoo Creek) and Yarungganyi, has worn a string of these

shells, as well as a bone, through his nasal septum. He places a string in Barili creek, where the men later find it. At once they realize what the object is, and they in turn decorate their initiation novices with it so that the boys may absorb the power of the shells and so become immune to it. (Meggitt 1969:129).

He also reports that women and children could not see the shells at close range for fear of death (Meggitt 1969:129, n.207). So important were these shells to the Walpiri that they are associated with sites that had their own dreaming track (Meggitt 1969:132). Although Meggitt was told that men had found the shells as fossils in the region, at the time he was working in the area (in the 1950s and '60s) the shells "drift in from the Kimberley coast" (Meggitt 1969:129, n.207), which is well over 1000 km away. Scaphopod species occur in coastal waters around most of Australia (Atlas of Living Australia) and so it is conceivable that the shells may have been traded from northern waters but even so some 1000 km from the nearest coastline. These observations seem to mirror that of the baler and pearl shell records from the central desert. The further from the source, the more powerful the objects become.

The antiquity of these trading networks is difficult to ascertain, as rare objects are not likely to be found in archaeological sites. However, in addition to the scaphopod shells reported here, fragments of baler and pearl shell have been reported from inland sites. The oldest of these are some baler shell pieces dated to ca. 32,000 cal BP and recovered from Widingarri Shelter 1 in west Kimberley (O'Connor 1999a:60, 121). Baler shell in contexts dating to ca. 22,000 cal BP was also recovered from the Silver Dollar site, Shark Bay in the Pilbara (Bowdler 1990). At the time of their deposition these sites were 70–100 km inland. There are no dates of that antiquity for desert sites further inland but Smith and Veth (2004) have obtained direct dates of more than 200 years cal BP on baler shell fragments collected from open sites in the Great Sandy Desert from a site over 400 km inland. Apart from these dates, and those reported here, all inland baler, pearl fragments occur in recent contexts.

Discussion and Conclusions

Beads of various organic materials have been an ornament used by Aboriginal societies since Pleistocene times. However, despite the abundance of decorative shells around Australia's coastlines, shell beads had a very restricted distribution in Aboriginal Australia. They were only made in the northwest of Australia and in Tasmania. This regional distribution of bead raw material types and the over 35,000 years BP antiquity of northwest shell bead-making, is reflected in other material culture forms, most notably, edge

ground axes (Balme and O'Connor 2014:170; O'Connor et al. 2014).

In addition to these regional differences in broad raw material types, people were also very selective about the particular shell species they used. In northwest Australia, only two shell types are recorded to have been made into beads – *Conus* sp. (probably *Conus dorensis*) and undetermined (because of the absence of the critical identifying posterior element) scaphopod species. Only one example of *Conus* use is recorded and these are the beads recovered from Pleistocene deposits at the Mandu Mandu site. All the remaining beads are scaphopods. In addition, two other much larger kinds of shell, *Melos* sp. and *Pinctata* sp. are frequently recorded to have been curated and strung as pendants. There is no doubt that ease of access and abundance of the scaphopods, and perhaps the lack of processing required, would have contributed to their selection for bead-making. But, other gastropod and bivalve shells are also very abundant on beaches, many naturally perforated. Baler shell and, until the advent of the pearling industry, pearl shell are not so easily obtained. It seems likely then, that the shells were selected for the other quality shared by all three types, that is, their bright, and shimmering surfaces and, for pearl shell, iridescence. These features, including iridescence, are also shared by the maireener shells that dominate the beads made by Tasmanian Aboriginal people but are not so evident in the patterned *Conus* shells. Could these qualities that were associated with spiritual and magical power at European contact have a deep antiquity?

We have discussed the ethnographic evidence for increasing social value and power that the shell items obtained as they moved inland. If the same situation pertained in the past it would be expected that the more accessible the raw material was, the more common would be the shell artifacts made from it, and that the converse would apply, that is, the further inland the shells moved the scarcer the beads would be in archaeological deposits. However, this is not the pattern that exists. Shell beads have not been found in coastal sites although they are widely observed to have been worn in the post-Contact period and many necklets of scaphopod segments from the Kimberley coast can be found in museums. This is not just a matter of sampling as more shelter sites have been excavated in the coastal Kimberley (O'Connor 1999b; Veitch 1996), as well as open sites and middens with excellently preserved shell food refuse and other shell tools (O'Connor 1999b; Veitch 1999). These include shell modified for domestic use such as baler shell bowls, knives and adzes (O'Connor 1999a:36, 1999b:39). Could the differences in distribution of beads in sites be due to the different contexts in which they were used and the different value and meaning they had as a result? Scaphopod shell is readily collected from sandy beaches along the northern Australian coastline. It is possible that the mere fact of their ease of replacement mitigated against the return

of beads to habitation sites. If a strand broke it may simply have been discarded, rather than the shells collected up, wrapped and transported to the habitation site for reuse in another decorative item.

Shell beads are found in greatest frequency in southern Kimberley shelters that were at least 150 km from the coast where they appear in greatest numbers from ca. 8000 years ago. These sites contain spun fiber string fragments and a range of subsistence resources usually associated with women's foraging, such as small mammals and reptiles, freshwater shellfish and plant remains, which we believe indicates that they were used for general-purpose habitation by extended family groups. For this reason, we have argued that in the southern Kimberley the scaphopod beads were likely worn in secular rather than sacred contexts. However, the shells were not readily available and could not be easily replenished as they could in the coastal supply zone. It is therefore likely that they were reused and curated and therefore were lost or discarded at the habitation site. The small size of some segments recovered may indicate a high degree of recycling of shell segments. This period also marks the end of rising sea levels and may reflect not the beginning of trade networks, but rather the changed location of the sites relative to the coast.

Although ethnographically scaphopod beads are observed to have been traded inland into central desert regions of Australia where they were objects of great power and value, they have never been reported from desert archaeological contexts. This is hardly surprising as, although they were rare and valued, they were also dangerous and powerful. The sacredness of the objects themselves would preclude their use (or discard) at general habitation sites. Today, similarly powerful objects are hidden in deep crevices between ceremonies lest they be accidentally seen, or ritually disposed of after use. They are also only used in designated law grounds or sites where their power can be controlled by ritual leaders.

There are three general archaeological points to be made from the discussion above. First, while archaeologists often interpret the presence of beads as evidence of identity markers of social categories within groups and between groups, one of the main points to emerge from the evidence discussed here is that the same beads may have very different meanings throughout their life history. The ethnographic evidence for scaphopod beads and other shell ornaments indicate that at their point of origin they are used in both secular and ceremonial contexts by a variety of social categories but, as they were traded inland their use narrowed. The second point is that the attributes that archaeologists use to analyze bead distribution, especially morphology, may well not be qualities that were of prime importance to the maker of the beads (a point also made by White 2007:299). Third, the distribution of beads in

archaeological landscapes may not necessarily reflect their abundance or use but rather the value or meaning with which they were vested. These values and meanings may change as a result of social re-organization and associated ceremonies but also as a consequence of changing access to beads, for example from sea level changes that result in changes to the distance to shell sources and from access to new modes of transport.

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Magdalenian “Beadwork Time” in the Paris Basin (France): Correlation between Personal Ornaments and the Function of Archaeological Sites

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Olivier Bignon-Lau and Pierre Bodu*

Abstract: *The purpose of this work is to identify whether there was a particular time for the hunter-gatherers of the Paris Basin to do their beadwork. From the creation of a regional database of 16 occupations dating from the Upper Magdalenian period, we correlate the study of ornament remains with the function of occupations. In this way, the results show that Magdalenian people did not produce beads everywhere and all the time. Indeed, the beadwork activity seems to have been practiced out of occupations where collective efforts were focused on intensive hunting tasks. In the Paris Basin, the production of beads was identified in only two levels at the site of Pincevent, which present particular occupation modalities. Both levels are characterized by a diversification of those domestic activities that occurred at times less governed by hunting activities during unspecialized occupations. In both examples, the currently available data on seasonality indicate that bead production may have taken place between the winter and spring. In addition, all the evidence collected in this paper shows that autumn was not a good time for this activity. Hence, the “beadwork time” seems to occur only in a particular and favorable context of the Magdalenian annual cycle.*

Introduction

This paper focuses on the personal ornaments of the Magdalenian hunter-gatherer populations of the Paris Basin, in France. The Magdalenian is a cultural entity dating to the end of the Paleolithic period. It is well represented in the western part of Europe. The objective of this work is to examine the position of bead activity in the territorial occupation pattern of these populations by identifying whether there was a preferred time of year for doing beadwork, which here is called “Beadwork Time.”

The examination of ancient hunter-gatherer subsistence-settlement strategies is based on territorial organization patterns and the reconstruction of the function of sites (Binford 1980). Ethnoarchaeological works teach us that bead production varies with the socio-economic system and territorial occupation pattern (Arnold and Munns 1994; Graesch 2004; Gray 2009; Kenoyer et al. 1991; Masucci 1995; Sciamia and Eicher 1998). However, symbolic

artifacts are investigated in very few studies (Stiner et al. 2013; Whallon 2006). The cognitive, symbolic and identity significance of ornaments globally tends to isolate them from this issue. On the one hand, these decorative objects are extensively used in the debate on the origin of humanity (see Ambrose 1998; Balme and Morse 2006; Bar-Yosef et al. 2009; Bednarik 1995; Bouzougar et al. 2007; d’Errico et al. 1998; d’Errico et al. 2005; d’Errico et al. 2003; d’Errico et al. 2008; Kuhn and Stiner 2007a, 2007b; Orton 2008; Vanhaeren and d’Errico 2005; Vanhaeren et al. 2006; Zilhão 2007; Zilhão et al. 2010). On the other hand, they have also largely contributed to investigating cultural phenomena and reconstructing circulation patterns (see Álvarez-Fernández 2001; Bar-Yosef 1989; Eriksen 2002; Fullola et al. 2007; Stiner 2003; Taborin 1993; Vanhaeren and d’Errico 2006). However, recent research recommends integrating the ornament data in studies of site function and examining the beads by means of a contextual approach

bringing together the detailed analysis of these objects in the cultural, economic and functional history of the site (Bachelier et al. 2011; Stiner et al. 2013; White 2007).

Our study of the variability of bead-making by the Magdalenian groups in the Paris Basin was initiated by works that have been carried out over recent years on the last occupation level of Pincevent (Seine-et-Marne), called level IVO (Bodu et al. 2006). One of the special features of the occupation is that it has provided nearly 300 ornament objects and associated products (raw material and manufacturing discards). The large number of remains related to ornaments and evidences of every manufacturing stage indicate that it is a site of production (Bodu et al. 2006). This activity has not yet been well documented for the Magdalenian groups of the Paris Basin. Therefore, the abundance of ornament pieces in an occupation site constitutes a new characteristic for these sites. This irregular presence of ornaments suggests that the beadwork activities of these nomadic hunter-gatherer populations were split in time and space, as has already been observed and documented for their other activities (Audouze 2006;

Olive and Pigeot 2006). In order to model the organization of ornament production of the Magdalenian population in the Paris Basin, we have developed a multidisciplinary approach that correlates the study of ornaments with the functions of sites. The purpose of this work is to answer two questions: when and in what context were the ornaments made?

Magdalenian Population in the Paris Basin

Geographic, Climatic, and Chronological Context

The Paris Basin is a large geographic and geologic area situated in the north of France, around the city of Paris (Fig. 3.1). There is much data available on this region; a little over forty Magdalenian sites are known to date. There is a high concentration of occupations in the south of Paris, but evidence also indicates settlement expansion in the northern and western part of the region. Compared to neighboring regions, the Magdalenian culture of the Paris Basin is a well-defined entity that has specific attributes corresponding to a chronological divergence between the different Magdalenian regions (Bodu et al. 2009; Debout et al. 2012).

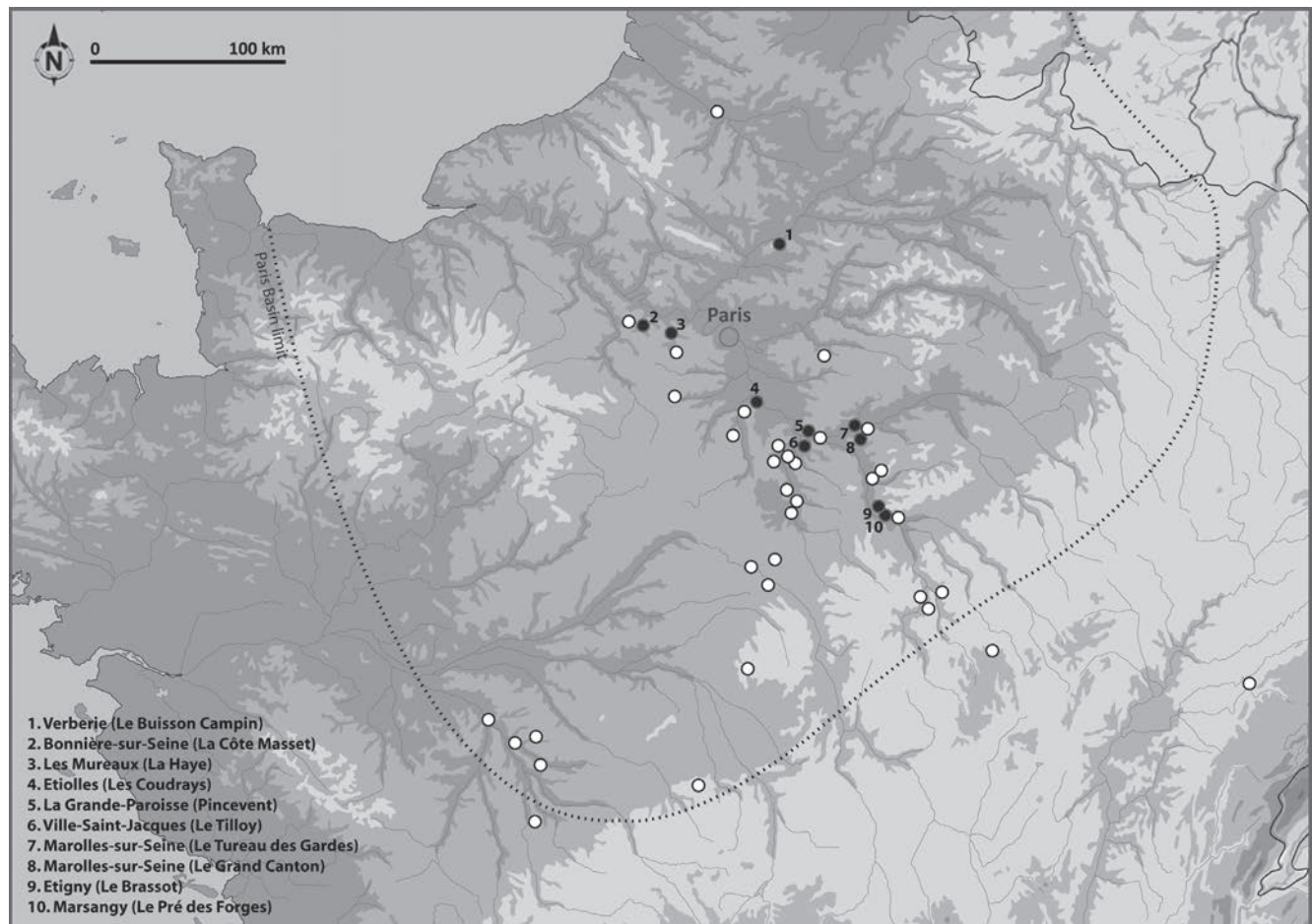


Figure 3.1 Magdalenian sites in the Paris Basin. Numbered black circles are sites referred to in this paper. Illustration prepared by G. Debout (redrawn from Debout et al. 2012:fig. 1).

Radiocarbon dates for the Paris Basin sites range from 13,200 to 11,950 cal BC (Debout et al. 2011, 2012; Valentin 2008). All these sites are attributed to the Upper phase of the Magdalenian period (Fig. 3.2). The first occupations date to the end of the cold climatic episode of Heinrich 1 (GS-2a), others date to the warmer episode of Bølling (GI-1e and GI-1d) (Debout et al. 2012).

Well-Preserved and Stratified Sites for a Palethnographic View

The Upper Magdalenian sites of the Paris Basin are characterized by the quality of their preservation (Fig 3.3), particularly in the Seine Valley open-air sites of Étiolles, La Haye, Pincevent, Verberie and the sites of the Seine-Yonne confluence. These sites provide some well-preserved occupations where the remains are almost unaltered and found in their original position. The remains are organized into units composed of a main fireplace around which zones of domestic activity – flint-knapping, leatherworking, butchering – and disposal areas occur. Based on this high-resolution evidence, the notions of habitation (a single unit) and camp (multiple units) were defined to refer to these Magdalenian occupations in the Paris Basin (Olive et al. 2000).

These sites were studied using the palethnographic approach elaborated by André Leroi-Gourhan at Pincevent. This approach is based on the excavation and the analysis methods presented in reference publications devoted to habitation no. 1 and section 36 (Leroi-Gourhan and Brézillon 1966, 1972). Continuously used over the last 50 years in the Paris Basin, these research methods have permitted the question of the function of sites and their integration within a territory to be developed, resulting in a better understanding of mobility patterns (Audouze 2006, 2007; Bignon 2007a, 2008; Julien 1989; Julien et al. 1988; Olive 2004; Olive and Pigeot 2006). These patterns suggest a territorial exploitation that was organized around an annual cycle of activities, based on fluctuating objectives of hunting horses and reindeer. Hence, one finds seasonal construction governed by settlement of unequal length, lasting from a few weeks to several months.

In addition to their good state of preservation, some sites are stratified. Between five and fifteen occupation levels are known at Pincevent, Étiolles and Verberie. They are separated by thin deposits of alluvia rapidly piled up by the annual overflows of the River Seine. The formation of these sequences is estimated to have occurred over a few generations, perhaps with the same individuals coming back repeatedly (Bodu 2010; Julien and Karlin 2002; Rodriguez and Roblin-Jouve 2004). These successive return visits to the same place confirm the regularity of displacements and allow functional variability of the occupations within the same site to be studied.

Personal Ornaments Data

With such high-quality information, the Paris Basin constitutes a field of regional study that is privileged and unique for the problematic we present here. In addition, the ornaments have a thematic and technical homogeneity that shows these Magdalenian populations engaged in the same ornamental practices.

Fossil Shell Bead Production

As for the other components of the archaeological assemblage, ornaments display an obvious standardization over the entire Paris Basin. So far, nearly 400 ornaments have been discovered. These beads are mainly composed of fossil seashells (Tab. 3.1). Among the more commonly used taxa, *Bayania lactea* and *Dentalium* sp. are the most

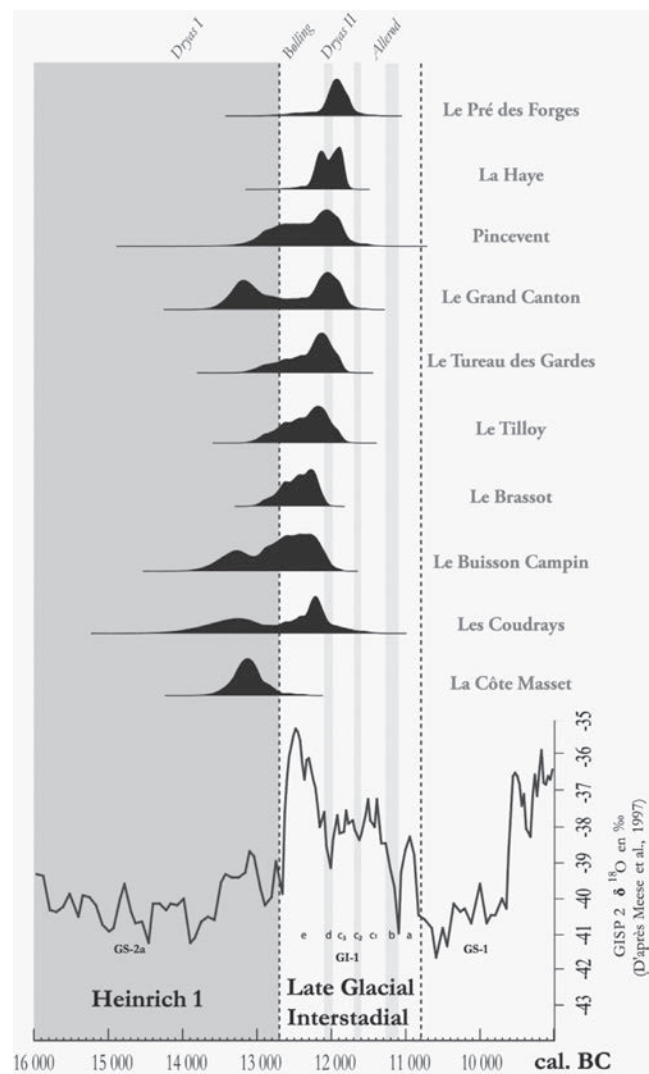


Figure 3.2 Chronological and climatic contexts of the Magdalenian culture in the Paris Basin. Illustration prepared by G. Debout (redrawn from Debout et al. 2011:fig. 10).



Figure 3.3. Preservation conditions at the Seine Valley open-air sites : a. La Haye, from Debout et al. 2011; b. Pincevent (photo by Centre archéologique de Pincevent); c. Étioilles (photo by Centre archéologique d'Étioilles).

recurrent ones. *Ampullina parisiensis*, *Granulolabium scruposum*, *Ancillus buccinoides*, *Athleta bulbulus*, *Sigmesalia multisulcata*, Potamididae and *Turritella* sp. are also found in several sites.

The other ornaments were mostly discovered at Pincevent. They consist of perforated pebbles and stone slices (lignite, limestone and sandstone) as well as some other materials including fossil shark teeth, ammonites and belemnite rostra. Less common are ornaments comprising animal teeth, represented by a series of sawn reindeer incisors discovered in level IV20 at Pincevent (Vanhaeren 2006).

Magdalenian people mainly exploited regional resources. In fact, throughout the Paris Basin, only one shell came from a distant source: a *Nucella lapillus* shell, a Pleistocene Atlantic species, discovered in unit A14 at Étioilles (Taborin 1993). The other shells came from regional fossiliferous formations. Indeed, the Paris Basin is composed of marine sedimentary rocks dating from the Eocene period, fifty million years ago. These sedimentary formations contain a large number of well-preserved shell species. Today, hundreds of fossiliferous sites are known containing more than one thousand species. Nevertheless, Magdalenian

people chose only a few types to make their ornaments; only about fifteen taxa were identified on these sites. This deliberate selection demonstrates a common ornamental theme.

The manufacturing techniques are also standardized. Shells were transformed by one perforation only. These perforations are always made by an abrasion technique, on the side that contains the original aperture of the shell. The perforation position and the wear traces suggest that the shells were assembled in the same way, probably using a sewing method.

Creation of a Regional Database

In order to correlate the study of ornaments with the function of sites, we created a database that combines 16 occupations dating from the Upper Magdalenian of the Paris Basin (Tab. 3.2). This represents a little more than a third of the known sites in the region. This sample includes the occupations in which hard animal material is preserved – that is to say, where data on ornaments and fauna are available, and which were excavated over an area of at

Table 3.1 Composition of Magdalenian personal ornaments in the Paris Basin. Sources: Schmider et al. 1995; Taborin 1993, 1994; Vanhaeren 2006.

		Pincevent	Étiolles	Verberie	Tureau des Gardes	Grand Canton	Ville Saint Jacques	Marsangy	Lagopède shelter
Fossil shell	<i>Bayania lactea</i>	x	-	x	-	x	-	x	x
	<i>Granulolabium scruposum</i>	x	-	-	-	-	-	-	x
	<i>Ampullina parisiensis</i>	x	-	-	-	-	-	-	x
	<i>Rhinoclavis unisulcata</i>	x	-	-	-	-	-	-	-
	<i>Ancillus buccinoides</i>	x	-	x	-	-	-	-	x
	<i>Melanopsis ancillaroides</i>	x	-	-	-	-	-	-	-
	<i>Sigmesalia multisulcata</i>	x	-	x	-	-	-	-	-
	<i>Cryptoconus lineolatus</i>	x	-	-	-	-	-	-	-
	Potamididae	x	x	x	-	-	-	-	-
	<i>Amalda canalifera</i>	x	-	-	-	-	-	-	-
	<i>Olivella parisiensis</i>	x	-	-	-	-	-	-	-
	<i>Rimella fissurella</i>	x	-	-	-	-	-	-	-
	<i>Turritella</i> sp.	x	x	x	-	-	-	-	-
	<i>Athleta bulbulus</i>	x	x	-	-	-	-	-	-
Shell	<i>Velates</i> sp.	-	-	x	-	-	-	-	-
	<i>Dentalium</i> sp.	x	x	-	x	-	x	-	-
	<i>Nucella lapillus</i>	-	x	-	-	-	-	-	-
Fossil	Shark tooth	x	-	-	-	-	-	-	-
	Belemnite rostra	x	-	-	-	-	-	-	-
	Ammonite	x	-	-	-	-	-	-	-
Stone	Sandstone slice	x	-	-	-	-	-	-	-
	Limestone slice	x	-	-	-	-	-	-	-
	Brown coal	x	-	-	-	-	-	-	-
	Pebble	x	-	-	-	-	-	-	-
Tooth	Reindeer incisor	x	-	-	-	-	-	-	-

x = presence; - = absence

least 10 square meters. We estimate that this is the minimum size needed to be able provide information on the variability of the activities carried out in one habitation unit.

Data Connected to Ornaments. Firstly, the database gathers quantitative information organized around the presence/

absence of ornaments and the number of pieces discovered. To document the density of each occupation, we have established a ratio that measures the number of ornament remains by square meter excavated (OR/m²). Secondly, qualitative information is integrated into the database. It corresponds to data resulting from the technological analysis of ornaments. Finished items are distinguished from objects linked to the production process. This latter category is mainly composed of unperforated shells, generally represented in sequences and comprising a few selected species. They are considered to be unused shell material. Rough-outs and manufacturing rejects associated with stone production are also included in this category. In contrast, the majority of finished objects consist of perforated and worn out shells.

Data Referring to the Function of the Occupations. In our database, the function of sites is based upon three interrelated variables. The first concerns the proportionality of the activities. On the one hand, there are multifunctional occupations characterized by versatile activities represented in equivalent proportions, and on the other hand, there are occupations in which activities were “specialized”, meaning that one activity largely prevails. In the latter case, the nature of the main activity is named. The second variable indicates whether there were one or more occupation seasons. Reindeer and horse seasonal data are based on more accurate estimations of the animal’s age of death. Such estimations are based on dental eruption/replacement in juvenile specimens and the crown height method (Bignon 2003, 2008; Fernandez and Legendre 2003; Guadelli 1991; Habermehl 1975; Levine 1982, 1983; Miller, 1974, 1976; Petit 1939). In order to get a more accurate estimate of age of death in juvenile horses, we used the crown height method applied to deciduous premolars which yields high statistical significance (Bignon 2006, 2007b, 2008; Tab. 3.3 and Fig. 3.4). The last variable corresponds to the duration of the occupation: either short or long. Duration is defined by the density and organization of the accumulated remains. For example, the weights of heating stones and their stage of fragmentation are regular indicators of the use-life of the main fireplace in a habitation. Associated with data on seasonality, the variable of occupation duration sometimes makes it possible to determine whether the settlement was occupied continuously or discontinuously.

Quantitative Variability

The first result is that the quantitative variability of ornaments is confirmed. Indeed, ornament numbers vary from site to site (Fig. 3.5a). Four occupations contain no pieces whatsoever, seven contain less than 10 pieces, four occupations contain between 10 and 50 pieces, and only one occupation delivered more than 200 pieces.

The ratio of ornaments remains by excavated square meter reveals a slightly different distribution: it clearly

Table 3.2 Database of personal ornaments and the function of Magdalenian sites in the Paris Basin. Sources: Barois-Basquin et al. 1996; Bignon 2007a, 2008; Bodu et al. 2006; Connet et al. 1999; Debout 2007, 2010; Debout et al. 2011; Julien and Rieu 1999; Leroi-Gourhan and Brézillon 1966; Taborin 1994; Zubrow et al. 2010.

Site	Occupation	Excavated m ²	Ornament remains	Number	Finalized objects	Raw material /rough	Ratio (OR/m ²)	Activities	Main activity	Season	Length of time
Verberie (Le Buisson Campin)	Locus 2	210	Presence	10	Presence	Absence	0.05	Specialized	Hunting	Autumn	Short
La Côte Masset	Level 4a	–	Absence	–	–	–	–	–	–	–	–
La Haye	Unit G13	15	Absence	–	–	–	–	Specialized	Hunting	Autumn	Short
Étiolles (Les Coudrays)	Unit U5/P15	800	Presence	33	Presence	Absence	0.04	–	–	–	Short
Étiolles (Les Coudrays)	Unit Q31	120	Presence	2	Presence	Absence	0.02	–	–	–	Short
Pincevent	Level IV0	1300	Presence	298	Presence	Presence	0.23	Unspecialized	–	All the seasons	Long continuously
Pincevent	Level IV21.3	250	Presence	31	Presence	Presence	0.12	Unspecialized	–	Winter to spring	Short
Pincevent	Habitation no. 1	70	Presence	3	Presence	Absence	0.04	Specialized	Hunting	–	Short
Pincevent	Level IV20	4500	Presence	37	Presence	Presence	0.01	Specialized	Hunting	Autumn	Short
Pincevent	Level IV40	150	Presence	1	Presence	Absence	0.01	Specialized	Hunting	–	Short
Pincevent	Level IV30	150	Absence	–	–	–	–	Specialized	Hunting	–	Short
Ville-Saint-Jacques (Le Tilloy)	Unit C151	20	Presence	1	Presence	Absence	0.05	Specialized	Butchery	Summer to autumn	Short
Le Tureau des Gardes	Locus 10	85	Presence	1	Presence	Absence	0.01	Specialized	Butchery	All the seasons	Short discontinuously
Le Grand Canton	Sector 2	1020	Presence	1	Presence	Absence	0.00	Specialized	Butchery	All the seasons	Short discontinuously
Le Brassot	Southern locus	200	Absence	–	–	–	–	–	–	–	–
Marsangy (Le Pré des Forges)	Unit D14	220	Presence	1	Presence	Absence	0.00	–	–	–	Short

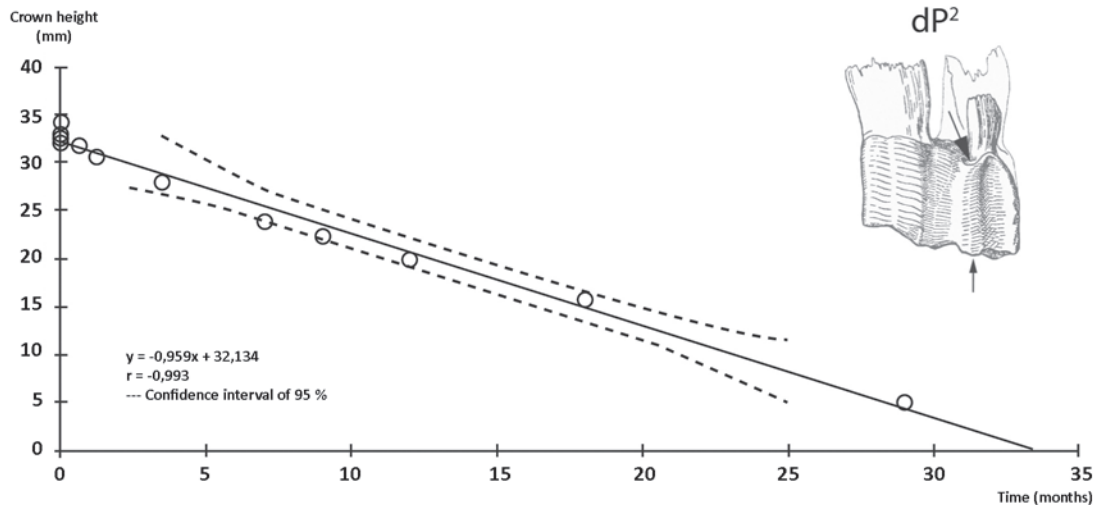


Figure 3.4 Linear regression and crown height landmarks of the second upper decidual premolar (dP²) (illustration by A. Lau-Bignon and O. Bignon-Lau, redrawn from Bignon 2003, 2006, 2007a, 2008).

Table 3.3 Calculating age of horse death using the linear regression data of the upper and lower dP² – dP³ tooth wear.

Horse decidual premolar (uppers, lowers)	Trend line of linear regression	Correlation coefficient (r)	Degrees of freedom (df)	Statistical significance (p)
dP ²	$y = -0.959x + 32.134$	$r = -0.993$	10	(0.01) = 0.7079
dP ³	$y = -0.957x + 33.65$	$r = -0.996$	10	(0.01) = 0.7079
dP ₂	$y = -0.8194x + 28.773$	$r = -0.993$	8	(0.01) = 0.7646
dP ₃	$y = -0.9364x + 32.205$	$r = -0.991$	10	(0.01) = 0.7079

shows two groups (Fig. 3.5b). We can define the first group as having a very weak ratio of ornaments per square meter, with less than 0.06 OR/m². In contrast, the second group presents a high ratio of ornaments, with more than 0.1 OR/m². Significantly, that there is no occupation exhibiting intermediate ratios. This distribution reveals a clear partition that makes it possible to distinguish two types of occupations: those with no or few ornament remains and those with many ornament remains.

Occupations with No or Few Ornament Remains

Ornaments are absent or rare in most of the Magdalenian occupations of the Paris Basin. In our database, occupations with a low density of pieces are indeed the more numerous (88% of the corpus). Ornaments are totally absent in one-third of the occupations. In the other two-thirds, they are generally present in small numbers (one to three pieces), and more rarely a little better represented (over 10 pieces).

Occupations without Bead Production

Technological analyses have shown that in these occupations the ornaments consist overwhelmingly of finished objects. Indeed, a part of the occupations contained only one or two

Dentalium beads. That is the case at Pincevent – level IV40, at Étiolles – unit Q31, Tureau des Gardes and Ville-Saint-Jacques (Taborin 1994; Vanhaeren 2006). In other cases, at Marsangy and at Grand Canton, the beads comprise a single perforated *Bayania lactea* (Taborin 1993, 1994). The ornaments in habitation no. 1 at Pincevent are also composed of a single perforated *Turritella* sp., combined with two lignite slices (Leroi-Gourhan and Brézillon 1966, 1972; Taborin 1994; Vanhaeren 2006). The technological reading of these slices indicates that they are finished objects. The perforations are complete and the surfaces entirely polished.

In the occupations where ornaments are better represented, the compositions are generally similar to the ones described above. At Verberie, the fossil shells are probably perforated (Taborin 1993, 1994) and at Étiolles – unit U5/P15, objects comprise several perforated shells and about thirty *Dentalium* beads (Taborin 1994).

However, a special feature stands out in level IV20 at Pincevent. Like the other occupations, it contains a majority of finished objects. However, two rough-outs were also found in this level (Vanhaeren 2006). *De facto*, one belemnite rostrum and one pebble display a perforation in progress. Nevertheless, the nature of these objects suggests opportunistic manufacturing. At Pincevent and other sites, the presence of these curious, water worn objects,

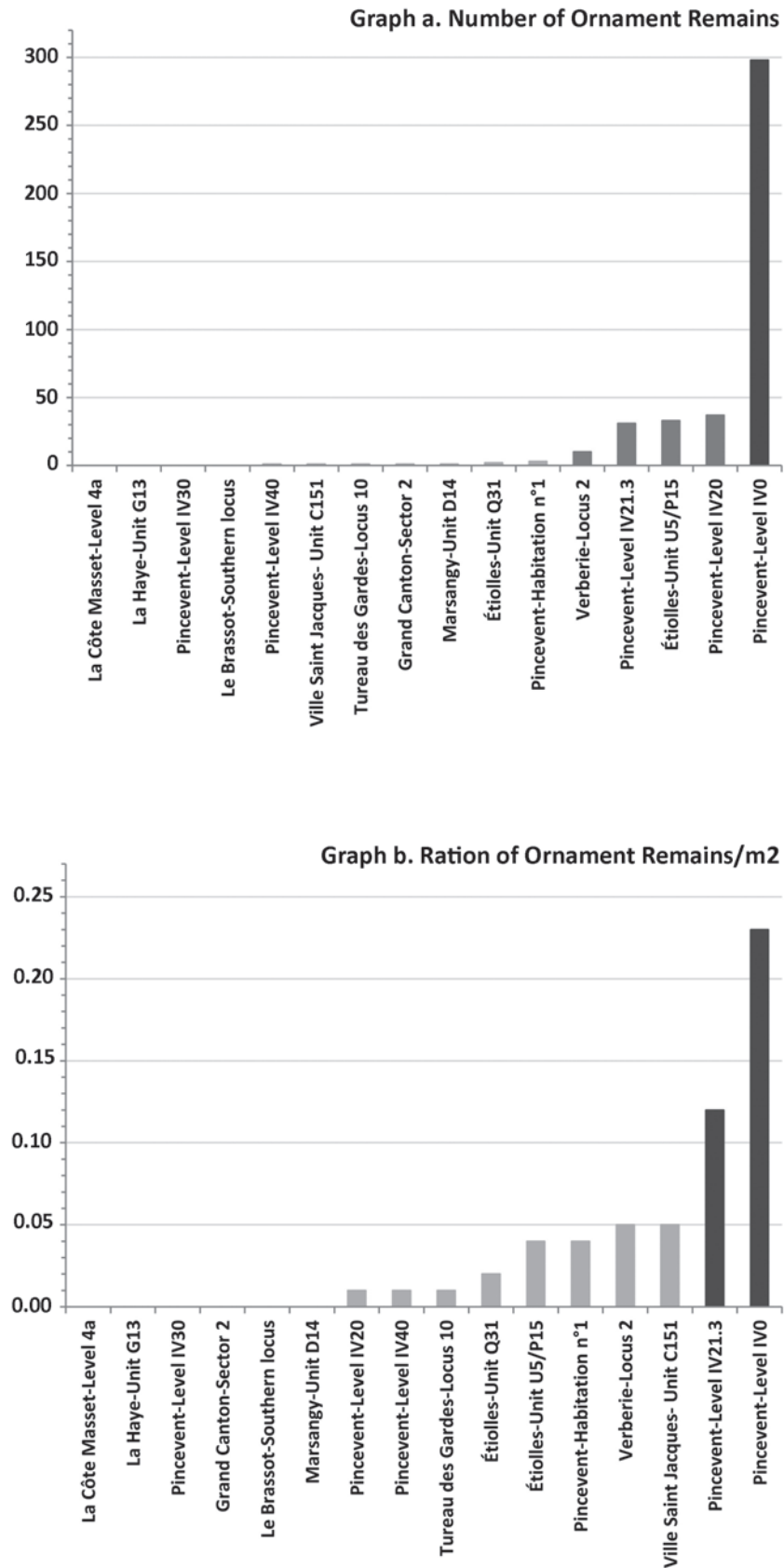


Figure 3.5 Quantitative variability of ornament remains in the occupations: a. number of items; b. ratio of ornament remains by square meter excavated (OR/m²) (illustration by C. Peschaux).

is generally attributed to random collection (Peschaux 2008; Vanhaeren 2006). Thus, specimens in level IV20 at Pincevent should not be considered remains of an activity aimed at producing ornaments for the group; rather they reveal some *ad hoc* individual manufacture.

In level IV20 at Pincevent, as in other occupations, there is neither waste nor raw material, unlike the sites of bead production (see below). In the absence of such evidence, it appears that no bead-working activity was organized in these occupations. Yet, it seems that the occupants were adorned. The presence of these finished items, found in small numbers, is rather due to random loss of some worn beaded objects.

The Function of Occupations: Specialized Subsistence Activity

Available data on the function of occupations with no bead working indicates the presence of some specialized activities connected to intensive hunting and butchering. Two types of occupation were identified: on the one hand, residential camps set up for the autumnal collective hunting of reindeer and on the other, non-residential installations set up for hunting and butchering horses and reindeer, throughout the year.

Reindeer clearly dominates the faunal spectra in the residential camps for collective hunting. At Verberie and in level IV20 at Pincevent, archaeozoological analyses revealed that reindeer was hunted *en masse* and in a collective way; *en masse* since the minimum number of individuals is estimated at between 20 and 80 killed animals, of varying age and gender. In a collective way because the quantity of killed animals presupposes the use of beating and interception hunting practices that required the participation of a large number of people. Moreover, post-hunt sharing of reindeer quarters among the different units was demonstrated (Enloe 1991; Enloe and David 1997). It is also assumed that reindeer was exploited partly in order to stock up on food (Julien and Karlin 2002). Data on seasonality have shown that the great hunting expeditions were organized in autumn when herds of reindeer seasonally migrated (David 1994; Enloe 1991; Enloe and David 1997; Leroi-Gourhan and Brézillon 1966). Being limited to the autumnal period of migrations, these collective camps appear to be fairly short-time occupations. The occupation period is estimated to have lasted between six and eight weeks (David 1994). Indeed, the density of the remains, particularly of stones displaying marks of fire and domestic tools, is much less compared to other settlements that were occupied for longer periods of time (Julien 2006). The same function is attributed to several other occupations with no beadwork as in habitation no.1 and levels IV40 and IV30 at Pincevent (Bignon et al. 2006), and the site of La Haye (Debout et al. 2011).

The absence of beadwork is also demonstrated in another occupation modality in which the activities are also specialized in hunting, and more particularly in butchering. At sites situated at the Seine-Yonne confluence such as Marolles-sur-Seine

(Tureau des Gardes and Grand Canton) and Ville-Saint-Jacques, a distinctive feature of the occupations is the co-dominance of horse and reindeer (Bignon 2007a, 2008). At Marolles-sur-Seine, the faunal spectra are largely dominated by horse (Bridault and Bemilli 1999; Julien and Rieu 1999). This taxon is also well represented at Ville-Saint-Jacques although reindeer slightly dominates there. Estimated between 25 and 120 killed animals depending on these sites, these high MNI values reveal some intensive hunting activities directed toward these two taxa (Bignon 2007c, 2008; Degros et al. 1994). Mortality profiles indicate various hunting tactics were used, ranging from collective tactics practiced at the end of autumn after the reindeer migration to individual hunting practiced when animals disperse maximally toward winter and summer pastures (Bignon et al. 2006; Bignon 2008; Bridault and Bemilli 1999). The occupations at Marolles-sur-Seine are very near to some kill sites where the first butchery treatments were carried out. The anatomical representations and the presence of flesh cutting traces show that activities were specialized in intensive butchering. On the whole, seasonal data for horses indicate that settlements were established throughout the annual cycle. Nevertheless, occupations of Tureau des Gardes (TDG 10) are equally frequent from the spring to the autumn, but occupations seem more frequent during the spring and the summer at Grand Canton. Indeed, a lower frequency is reported during winter at Tureau des Gardes and Grand Canton (Bignon 2008; Bridault 1996; Bridault and Bemilli 1999). Also, data on Ville-Saint-Jacques place the occupation at the end of summer and at the beginning of autumn (Bignon 2007c; Degros et al. 1994). At Grand Canton, the density and spatial distribution of the remains suggest a series of short and successive non-residential occupations, rather than continuous settlement throughout the year (Julien and Rieu 1999; Lang 1998). Indeed, the site excavations yielded about ten fireplaces whose strict contemporaneity could not be proven (Julien et al. 1999).

The fact that the occupations with no bead working were specialized in hunting activities leads us to discuss the composition of the social group. It is tempting to link the absence of bead production with a possible dispersion of the population at the time of hunting. Among sub-contemporary hunter-gatherers, hunting activities were more often assigned to men whereas beadwork tasks were usually assigned to women (Testart 1986). However, it appears that the entire social group was present in most of the Magdalenian occupations in the Paris Basin. This was the case particularly at Étiolles (Pigeot 1987, 2010) and at the camps of collective reindeer hunting at Pincevent and Verberie (Ploux 1989; Karlin et al. 1990; Audouze 2006). From the detailed analysis of sequences of lithic production, research has revealed that flint knapping was practiced at different skill levels in the occupations. Some of the studied sequences turn out to be non-productive ones and sometimes show an alternation of skill levels. As a matter of fact, some debitage was performed successively by novice flint-knappers and by experienced

ones. These patterns are interpreted as signs of the presence of children learning flint-knapping. In levels IV20 and IV40 at Pincevent, the presence of women is assumed by the identification of activities linked to the processing of hunting products such as processed leather (David et al. 1998; Debout 2007; Julien and Karlin 2002). These conclusions are still hypothetical but everything seems to indicate that these occupations dedicated to hunting could have been by complete family units composed of men, women and children. Thus, for Magdalenian people in the Paris Basin, the absence of bead production should probably not be linked with the absence of part of the social group.

Occupations with Remains of Numerous Ornaments

Fewer in number than the occupations with no or only a few beads, the occupations with many ornaments comprise only two levels at Pincevent (12% of the corpus). So far, level IV0 is the only occupation that has yielded many beads in the Paris Basin. One of the important results of this work is that it also brought to light a second occupation with a high density of beads: level IV21.3.

Bead Production Sites

In both occupations, the ornaments consist overwhelmingly of fossil shells (Fig. 3.6). They comprise similar species, with a very pronounced taste for *Ampullina parisiensis*. They also both contain fossil shark teeth. Level IV0 is distinguished by a stone component (sandstone, limestone and lignite) most of which was transformed into slices with a central perforation.

The technological analysis of the fossil shells encountered in these two levels at Pincevent has shown that they contain perforated pieces as well as unperforated ones (Tab. 3.4). In both occupations, unperforated shells are well represented, between 30 and 40% of the total number of items. They are found within large series of shells, dominated by a few selected species: *Rhinoclavis unisulcata*, *Ampullina parisiensis* and *Bayania lactea* in level IV0; *Ampullina parisiensis* in level IV21.3.

Morphometric analysis of the shells in level IV0 revealed that unperforated pieces display greater variability in their dimensions than perforated pieces which appear more standardized (Vanhaeren 2006). This morphometric differentiation indicates that the shells were sorted and selected locally to accommodate a predefined beaded

Table 3.4 Proportions of perforated and unperforated shells for each taxon in levels IV0 and IV21.3 at Pincevent.

	Perforated		No. perforated		No. applicable		Total
	nb	%	nb	%	nb	%	nb
Level IV-0							
<i>Rhinoclavis unisulcata</i>	65	66	28	28	6	6	99
<i>Ampullina parisiensis</i>	39	42	48	53	5	5	92
<i>Bayania lactea</i>	12	48	9	36	4	16	25
<i>Melanopsis ancillaroides</i>	9	75	2	17	1	8	12
<i>Sigmesalia multisulcata</i>	1	17	4	66	1	17	6
<i>Granulobium scruposum</i>	1	20	2	40	2	40	5
<i>Cryptoconus lineolatus</i>	2	67	1	33	–	–	3
<i>Batillaria</i> sp.	–	–	–	–	2	100	2
<i>Amalda canalifera</i>	–	–	1	100	–	–	1
<i>Olivella parisiensis</i>	–	–	1	100	–	–	1
<i>Rimella fissurella</i>	–	–	–	–	1	100	1
<i>Ditrupea</i> sp.	–	–	–	–	1	100	1
Total	129	52	96	39	23	9	248
Level IV-21.3							
<i>Ampullina parisiensis</i>	8	33	7	29	9	38	24
<i>Ancillus buccinoides</i>	–	–	2	100	–	–	2
<i>Olivella parisiensis</i>	–	–	1	100	–	–	1
<i>Natica cepacea</i>	–	–	–	–	1	100	1
Indeterminate	–	–	–	–	2	100	2
Total	8	27	10	33	12	40	30

nb = number; % = percentage

object. The presence of unperforated shells on the site may correspond to discards of raw material when beads were made. Morphometric analysis of the shells in level IV21.3, similar to that performed in level IV0, is not feasible. Because of a high degree of fracturing, the necessary parameters for a morphometric analysis cannot be applied to most of the pieces discovered so far. This taphonomic constraint is also the reason why the presence of perforation has been identified for 60% of all the shells (Tab. 3.3). However, the acknowledged presence of a significant number (33%) of unperforated shells, combined with the high density of ornament remains largely dominated by one species, is comparable to the data from level IV0. This obvious similarity suggests that the same activities of sorting and selecting shells for production were performed there.

The production of beads in level IV0 is also attested by the presence of rough limestone and sandstone slices (Vanhaeren 2006). To this, we add ten fragments of lignite (Fig. 3.6). All these items show some traces of work. Most of them are manufacturing rejects, and two are rough-outs. The first object is a fully shaped stick, probably a prepared blank for the production of a series of lignite beads (Fig. 3.6.2). The second one is a rough bead the surface of which had not been regularized (Fig. 3.6.3). No finished objects of lignite have been found in this level, suggesting that the produced beads were probably taken away.

Both production sites have also yielded perforated and use-worn shells that are generally a little more numerous than the unperforated specimens (Tab. 3.4). The identification of the broken perforations suggests that parts of these elements were lost during the occupations (Vanhaeren 2006). However, the large volume of perforated shells indicates that there was also another modality of accumulation. This abundance could be explained by on-site maintenance of beaded objects. Indeed, the perforations are often intact and most of them present some traces of pronounced use-wear. Perforated shells are mixed with unperforated ones in the production areas in level IV0. They are also found in small concentrations in the common disposal areas. From their position, these concentrations are interpreted as rejects of, more or less, complete beaded objects.

To summarize, the production sites are characterized by a high density of ornament remains composed partly of rough-outs, waste and raw material that consists generally of unperforated shells. The abundance of perforated and use-worn shells can also be linked to the production activity. In addition to the creation of new beaded objects, this may indicate some renovation of beaded objects.

The Function of Occupations: Unspecialized Activity

In the Pincevent stratigraphy, most levels correspond to camps for collective reindeer hunting. This succession of

occupations with similar functions leads us to consider the site as being in a strategic position in the annual cycle of activities, where large-scale hunting of reindeer was practiced during their fall migration. In this functional context, however, *a priori* stable, levels IV0 and IV21.3 display functional variability.

The activities found in both occupation levels are unspecialized. Their faunal spectra are equally dominated by reindeer and horse (Bignon 2008; Bignon et al. 2006). Hunts were characterized by different tactics, depending on the season. Most hunting was practiced individually or in small groups during the winter and summer maximum dispersion of animals. Absence of specialization is also observed in the composition of the lithic toolkits, which reflect a variety of activities that are represented in equal proportions. Quantitative analysis shows that domestic tools are better represented than hunting weaponry, whereas the ratio is reversed in the camps for collective reindeer hunting (Bodu and Debout 2006; Debout 2010; Julien 2006). For example, supplementing the maintenance of beaded objects, sewing seems to have played an important part in the activities in level IV0, judging from the numerous flint perforators, waste from bone needle production and polishers, and red coloring agents (Julien and Beyries 2006; Malgarini 2010). The diversity of activities is also remarkable in terms of the spatial structuring of level IV0 (Debout 2010). The main and adjoining workplaces proved to be versatile ones with a multiplicity of activities.

The diversity of activities in level IV0 can be explained by the duration of the habitation there. In fact, data on seasonality indicate an exceptionally long stay. Considered at first a winter camp (Bodu et al. 2006), the discovery of a second habitation unit has led to the formulation of new interpretations (Debout 2010). All seasons are now represented and show an occupation covering the whole annual cycle (Bignon-Lau 2010). The density and organization of the remains indicate that continuous occupation is the most likely scenario. The mass of heating stones, weighing almost 1,500 kg, indicates heavy-duty installations planned from the start for a long stay or corresponding to a lengthy accumulation of fire-related activities. Prolonged use of the main fireplaces is indeed demonstrated by numerous re-constructions and re-used stones (March et al. 2006). Analysis of the tools also points to prolonged or intensive use (Valentin 2006). However, the lengthy duration of the occupation does not seem to have been the motivation for these Magdalenian people to produce ornaments. On the contrary, given the current state of the excavations, it seems the density of the remains in level IV21.3 reflects a short-term occupation. The few available data on seasonality indicate an occupation that was set up some time around the end of winter and the beginning of spring (Bignon 2008).

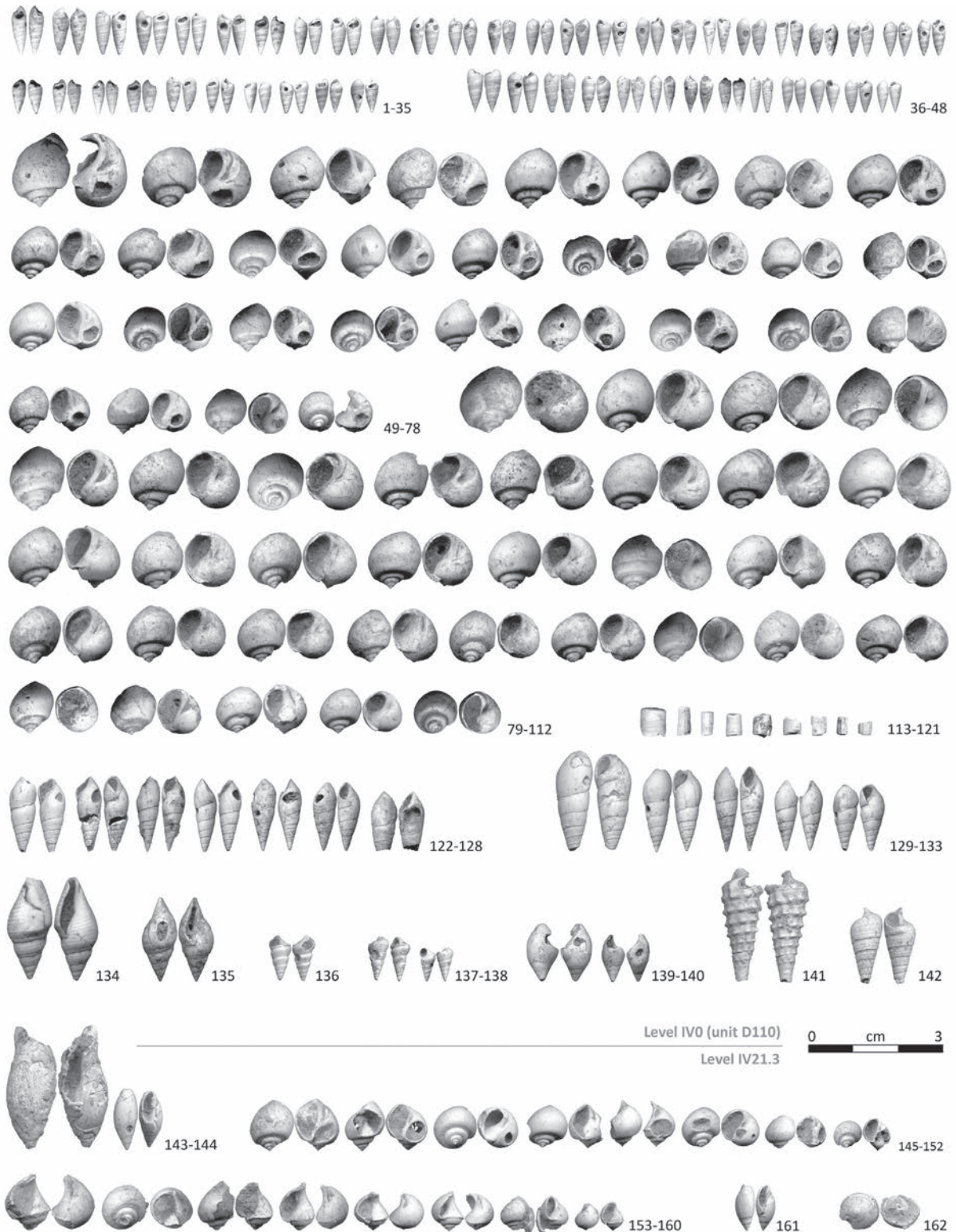


Figure 3.6 Shell beads and raw material in levels IV0 (unit D110) and IV21.3 at Pincevent. Level IV0: *Rhinoclavis unisulcata* perforated (1–35) and unperforated (36–48); *Ampullina parisiensis* perforated (49–78) and unperforated (79–112); *Dentalium* beads (113–121); *Bayania lactea* perforated (122–128) and unperforated (129–133); *Cryptoconus lineolatus* unperforated (134) and perforated (135); *Sigmesalia multisulcata* perforated (136) and unperforated (137–138); *Melanopsis ancillaroides* perforated (139–140); *Batillaria* sp. (141), *Granulolabium scruposum* unperforated (142); Level IV21.3: *Ancillus buccinoides* unperforated (143–144); *Ampullina parisiensis* perforated (145–152) and unperforated (153–160); *Olivella parisiensis* unperforated (161); *Natica cepacea* (162) (illustration by C. Peschaux).

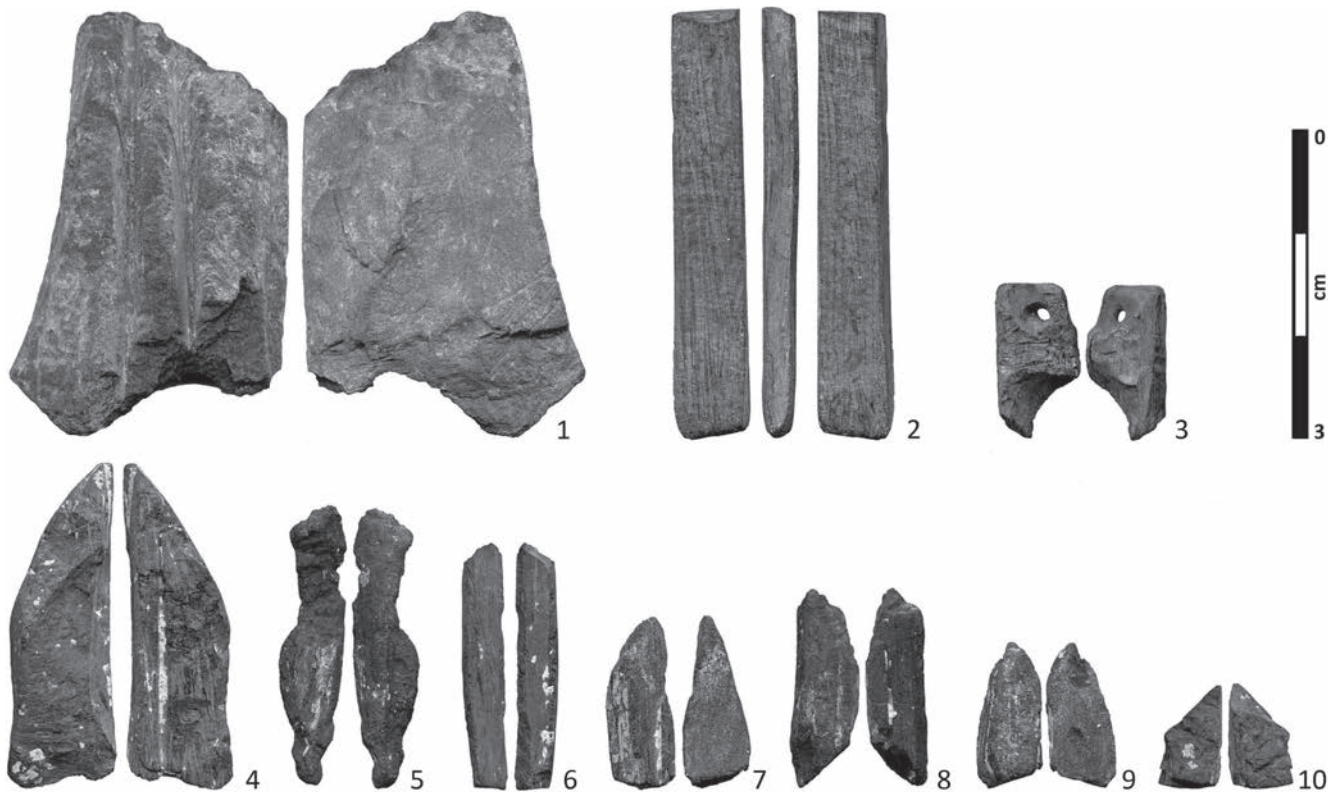


Figure 3.7 Lignite remains in level IV0 at Pincevent (illustration by C. Peschaux).

Magdalenian “Beadwork Time”

Bead Working: Not All the Time

As a first conclusion, the result of this work clearly indicates that Magdalenian people did not manufacture beads on every settlement. Most known occupations in the Paris Basin are places where no beadwork was carried out. The presence of finished objects, almost exclusively and in few numbers, indicates that beaded objects were indeed worn and occasionally lost on these settlements but were not produced there.

Sites of bead production are far less numerous. Level IV0 at Pincevent is currently the best-documented site. One of the benefits of this work is the evidence it gives for the practice of bead production in a second level at Pincevent: level IV21.3. Having excavated over 200 sq m so far, one of the future objectives of the Pincevent team is to extend the excavation of this level. In view of its potential to provide information on ornaments, it may bring new information on bead-making activities among the Magdalenian population in the Paris Basin.

Because of its stratigraphic position, level IV21.3 already highlights the fact that the manufacturing of beads does not seem to follow a chronological evolution. Indeed, the sequences at Pincevent show an alternation between production sites and non-production sites (Figure 3.8). Several generations

of Magdalenian people considered Pincevent to be a strategic place for large-scale hunting of reindeer during the fall migration. Yet, the observed functional variation indicates that there was sometimes a change in site status, at least twice. These upheavals may correspond to temporary adaptations to short-lived climatic phenomena, perhaps corresponding to climatic oscillations of the Bølling in the Paris Basin (Bignon et al. 2006). Indeed, both levels are positioned at the top of sedimentary cycles, loaded with sandy fractions, which represent abnormalities in the formation of the overall stratigraphic sequence (Orliac 1975, 1994, 2006). These abnormalities are interpreted as a temporary re-organization of the channels and an increase in the force of the floods of the River Seine. This environmental modification may have had an impact on the distribution of reindeer migration patterns, and thereby on the territorial occupation of the Magdalenian people.

Thus, the site of Pincevent appears to be a place where ornament production was practiced irregularly. Exceptional conditions were needed for the Magdalenian people to occupy the site at the time of bead-making. It is plausible that bead production was traditionally carried out elsewhere in the Paris Basin territory. The function of levels IV0 and IV21.3 thus provides evidence of some installation modalities that have not yet been recognized outside the occupations where bead production took place.

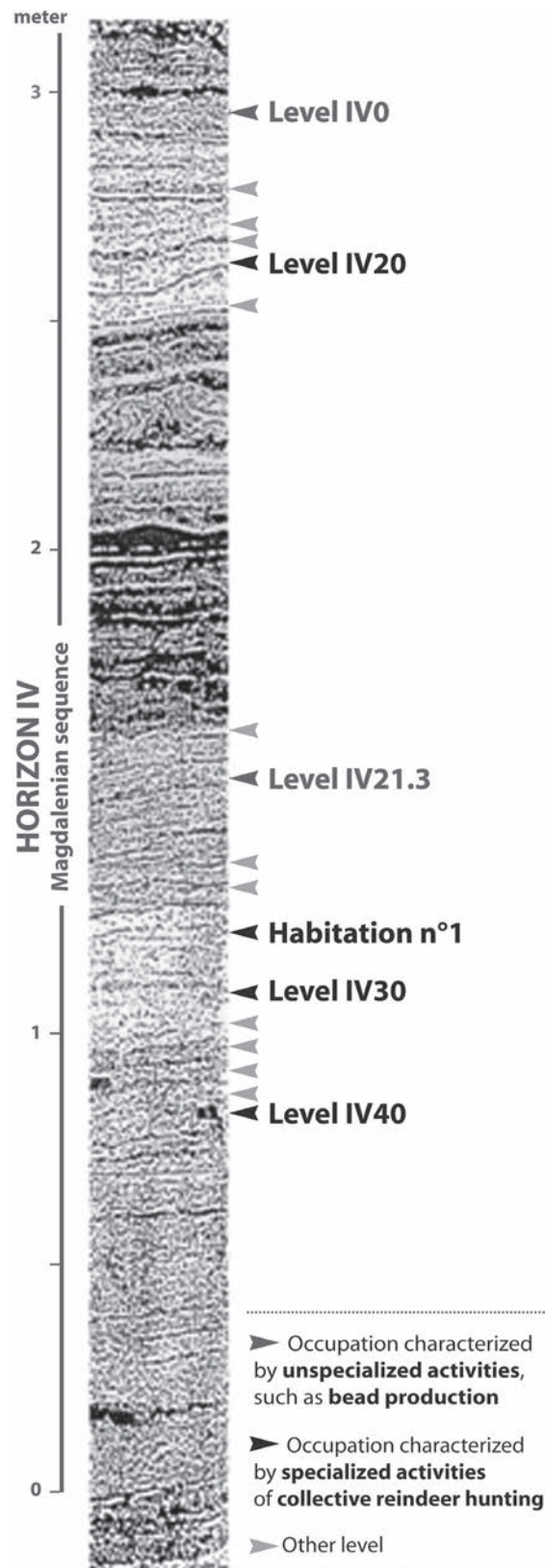


Figure 3.8 Changes in occupation functions in the stratigraphic sequence at Pincevent (illustration by M. Orliac, redrawn from Debout et al. 2012:fig. 8).

Bead Working: Outside the Periods of Collective Efforts

Thus, we note that a favorable context seems to be emerging for the beadwork time. Clearly, most of the occupations in our database show no signs of bead-making. All these occupations favor activities that are specialized in subsistence activities. The supposed intensity of the hunting tasks in the camps for collective reindeer hunting and in the occupations of reindeer and horse butchery apparently left no room for other activities. Occurring over short periods of time, it seems that these periods of intensive hunting required the attention of everyone in the social group. In this way, the time of bead-making in the Magdalenian seems to have taken place outside the period of collective effort.

Indeed, it appears that the absence of specialization is what best characterizes the occupations with bead production. In addition to the bead activities, the remains in levels IV0 and IV21.3 reflect various other activities. The maximum dispersion of the animals at the time of these occupations suggests that most hunting expeditions were led by a few individuals. That is when the beadwork time seems to intervene, in more favorable phases, for doing extra-alimentary and non-collective tasks since they are less governed by hunting constraints. It is in this context of diversification of activities that Magdalenian people chose to tackle the production and maintenance of their beaded objects.

Because of its continuity of habitation, the occupation in level IV0 offers all the requirements for bead-making. Covering an entire annual cycle, the periods favorable for domestic activities must have been frequent. Nevertheless, ornament production does not seem to be strictly dependent on the duration of the settlements. In spite of a briefer occupation, bead activities also took place in level IV21.3. As far as we know today, it appears that bead manufacturing could equally have been carried out during both long and short occupations.

Bead Working: Not in Autumn?

It is also difficult to tell today whether beads were produced during a particular season. However, several pieces of evidence obtained during our analysis show that autumn was not the right time for this activity. In fact, all the autumnal occupations recorded in this region contain no indications of bead working. In these occupations, the activities were focused on large-scale collective reindeer hunting that took place during the fall migration of the herds. These episodes, conducive to social gatherings, must have been important events in the yearly cycle of the hunter-gatherers of the Paris Basin. Apart from extensive stocking of food, the participation of all members of the group in the driving and interception, as well as in the sharing of the animal carcasses between the different units, reveal that these hunts were prominent in the socio-economic life of these societies. The social involvement of the Magdalenian people in these

autumnal occupations implies that the season was not favorable for doing beadwork. In addition, the end of autumn may have corresponded to periods of small collective hunting activity after the reindeer migration, targeting horses and reindeer that had started to scatter (Bignon et al. 2006). Between the phases of migration and animal dispersion, it is possible that no beads were produced all autumn long.

In addition, the absence of bead production in autumn is also observed through the spatial distribution of the ornament remains in level IV0. Indeed, the occupation is partly structured on the rhythm of seasons (Debout 2010; Debout et al. 2006). Analysis of faunal dental series shows that the different areas of disposal were dominated by a season of slaughtering. The data suggest a chronology in the formation of these concentrations. However, the bead distribution in habitation unit T125 shows a reduction in the density of items in the northern waste area that yielded indications that it was occupied in the autumn, whereas there are plenty of signs in the southeast waste area which produced indications of a winter occupation.

Hence, every clue we collected in this paper agrees that autumn was excluded as a time for bead-making. Yet it is still difficult to know whether or not the bead-working was a seasonal activity, limited to a specific time in the annual cycle of the Magdalenian people. Is bead production exclusively a winter activity? If the distribution of beads in unit T125 of level IV0 indicates winter production, their distribution in habitation unit D110 is more difficult to interpret. In this second unit, the remains accumulated over the four seasons occur in the same areas of activity and disposal. Given this distribution, it is therefore impossible to correlate bead working with a particular season in unit D110. On the other hand, level IV21.3 adds additional information. It indicates an occupation that was set up around the end of winter/beginning of spring, which places the bead activity a little later in the year compared to level IV0. The time for manufacturing beads therefore was surely not limited to the wintertime but probably occurred over a longer period.

Conclusions

In light of this research, it is now possible to say that a specific bead working time existed for the Magdalenian people in the Paris Basin. Analysis of the function of sites shows that bead activity occurred outside the periods of autumnal collective efforts – this observation is confirmed when the bead distribution is correlated with the seasonal structure of unit T125 in level IV0 – but certainly sometime between the winter and spring, according to the currently available data. On the other hand, there are few data to indicate whether or not summer should be added to this cycle. This notion of seasonality is important because it influenced the function of the occupations where the ornaments were being made. Indeed, bead production coincided with periods of maximum

dispersion of animals over the landscape. It is the time when non-collective domestic activities diversified in non-specialized occupations. It was therefore the favorable time for beadwork.

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Personal Adornment and Personhood among the Last Mesolithic Foragers of the Danube Gorges in the Central Balkans and Beyond

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Abstract: *In this paper, the authors discuss technological choices associated with the production and use of ornaments at the Late Mesolithic site of Vlasac in the Danube Gorges (Serbia). At this site, more than three thousand ornaments were found both in burials and dwelling contexts. Mesolithic beads are mostly represented by perforated marine and freshwater gastropods as well as carp pharyngeal teeth. The results of the technological, use-wear, and residue analyses carried out on the whole repertoire of ornaments from Vlasac are used here to understand the way social identities and personhood were constructed in this region of the central Balkans. Comparison with the adjacent areas of the Italian Peninsula and the Upper Danube region are also provided.*

Introduction

Bodily adornments, in the form of beads, pigments, pendants, appliques, feathers, etc. are known by most if not every contemporary human society and were used as a material strategy par excellence in the construction of the social-self. Due to their capacity for conveying social message visually, ornaments have often been considered a “communication technology,” a visual language through which personal and social information can be broadcast to intimate or distant audiences, thus contributing in creating and maintaining social networks at different levels (e.g. Kuhn and Stiner 2007; Strathern and Strathern 1971; Turner 1980).

Over the last three decades, archaeologists have explored the evolutionary implications of the use of bodily ornaments for the emergence of modern cognition and symbolic behavior in ancient populations (e.g. d’Errico and Stringer 2011; Kuhn and Stiner 2007; Vanhaeren et al. 2013; White 2007; Zilhão et al. 2010). Specific ornamental traditions defined by differences in the ways ornaments were produced and used have been considered as key for understanding past group identities (e.g. Newell et al. 1990; Rigaud 2011; Taborin 1993; Vanhaeren and d’Errico 2006). It has

also been suggested that ornaments due to their symbolic significance may in a diachronic perspective change at different rates than other diagnostic elements of material culture, with ornaments showing significant continuities over time in particular regional contexts and possibly being a better indicator of cultural continuities as an expression of stable world views (Perlès 2013:296).

Also, in archaeological accounts of various case studies, the presence of burials rich in ornaments has often been linked to the idea of inferring the social status of the deceased. This is especially significant in cases of child burials rich in ornaments. Even in the case of hunter-gatherer societies, child burials rich in ornaments have often been used to argue for established social inequality and hereditary ranking distinctions (e.g. Vanhaeren and d’Errico 2005; Wright 1978; for critiques of such straightforward connections between the abundance of ornaments and status of the deceased see for instance Byrd and Monahan 1995; Gamble 2007:149).

Ethnographic research has shown that in many social contexts, ornaments are directly linked to the construction of personhood and sense of individuality or dividuality. As the body and the sense of personhood are never constructed

in advance in such ontological universes, ornaments serve to construct the body/personhood. Interestingly, ethnographic evidence has shown that beads represent highly protective objects that, accordingly, are often associated with the protection of children who wear them in great quantities (Miller 2009). The type, diversity, quantity or range of different ornament types could directly relate to lifecycle stages by which a society marks/inscribes its members. Ornaments are thus often seen as extensions of the body surface or means of releasing the soul that resides within (e.g. Miller 2009; Santos-Granero 2009). Informed by ethnography, a relational approach has also been taken up by some archaeologists when discussing ornaments in different archaeological case studies as sets of materialities that are linked to processes described as the enchainment of identities resulting in distributed personhoods across time and space (e.g. Chapman 2000; Gamble 2007:144–152).

Staying at the level of ethnographic insights, body ornaments take an important role in mythologies of traditional societies, especially singled out by Lévi-Strauss throughout his *Mythologiques* series in relation to the genre of myths about the origin of ornaments in the Americas (e.g. Lévi-Strauss 1969, 1987, 1995). In our opinion, looking at the way mythological themes are spread among different related societies over vast territories or structurally inverted and transformed by neighboring and more distant groups that use similar cultural repertoires could be highly informative for archaeological case studies that look at recurrent patterns in the types of ornaments used in prehistory at regional as well as continental scales. Such an approach may turn out to be analytically more useful than one that tries to look at the distribution of ornaments as a direct mapping of past ethnic and linguistic groups.

Building on the idea that technological choices associated with ornament production and use are relevant for understanding the construction of social identities in past societies, in this paper we discuss the repertoire of bodily adornments shared by Mesolithic foragers of the central Balkans from ca. 7500 to 6200 cal BC, i.e. in the course of the regional Late Mesolithic, before these societies came into contact with the first Neolithic societies of the Balkans (see Borić 2011; Borić and Price 2013). Our focus is the site of Vlasac, found in the vicinity of the well-known and partly contemporaneous site of Lepenski Vir. At Vlasac. A very rich and well-preserved corpus of ornaments has been recovered in association with the best type of context imagined for an analysis of personal adornment in the past: the bodies of the deceased in inhumation burials. Here we integrate data from old excavations (1970–1971) with the results of new work at the site (2006–2009), allowing one to present a robust dataset for a more general discussion. Modern standards of archaeological excavation, which characterized more recent work at Vlasac, including careful recording of contextual information for such objects as ornaments along with an

increasingly refined chronological framework, help us better contextualize the larger corpus of burials with ornaments found in the course of the 1970s excavations at the site (Borić et al. 2014 and references therein).

The analyses of technological, use-wear, residue and contextual data available for different categories of ornaments recovered in burials and dwelling contexts at Vlasac contribute to our understanding of this Mesolithic foragers' identity and personhood construction. We compare the repertoire of ornaments from Vlasac with the corpus of ornaments found at other contemporaneous sites of the Danube Gorges in order to regionally situate this Late Mesolithic system of ornamentation. Finally, the specificity of this regional ornamental tradition is compared to several related European regional case studies and we draw a range of implications from this wider comparative perspective.

Site and Chronology

The site of Vlasac is one of the Mesolithic–Neolithic settlements discovered in the region of the Danube Gorges of the north-central Balkans. It is situated approximately 3 km downstream from the eponymous site of this cultural phenomenon in the Danube Gorges, the site of Lepenski Vir, in the Lady's Whirlpool Gorge of the Danube, on the Serbian side of the river (Fig. 4.1). First excavated in 1970 and 1971 by D. Srejović and Z. Letica (1978), Vlasac was the focus of new investigations from 2006 to 2009 (Borić 2006, 2007, 2011; Borić et al. 2008; Borić et al. 2009; Borić et al. 2014). The site was probably continuously inhabited and/or used as a burial ground throughout the Early and Late Mesolithic (ca. 9500–6200 cal BC), in the course of the Mesolithic–Neolithic transition period (ca. 6200–5950 cal BC), when the first pottery and other elements of the Neolithic “package” appeared in the region, and throughout the regional Early/Middle Neolithic (ca. 5950–5500 cal BC). Occupation phases of the site are framed by a suite of 45 radiocarbon dates from both old and new excavations: 17 charcoal dates and 29 AMS dates (14 on human and 14 on animal bones, while one date has come from charred plant remains) (Borić 2011; Borić et al. 2008; Borić et al. 2014). The majority of the measurements (33 dates) cover the Late Mesolithic period (ca. 7400–6200 cal BC), suggesting an intense occupation at the site during this phase.

Late Mesolithic domestic features, such as the remains of at least five trapezoidal dwellings and 27 rectangular (open-air?) stone-lined hearths as well as burials were found at the site (Borić 2007b; Radovanović 1996; Srejović and Letica 1978). In the course of the 1970s excavations, a total of 87 graves, containing either 119 individuals (Nemeskéri 1978) or 164 individuals (Roksandić 1999, 2000) were discovered. Another 17 formally interred primary and secondary burials were excavated in 2006–2008, while the minimum number of individuals (MNI) for this recently



Figure 4.1 Map of the Danube Gorges showing the locations of Late Mesolithic sites.

acquired assemblage is 16 (Borić et al. 2014). There are 30 additional contexts with disarticulated human bones. Among the buried individuals from both excavation phases at the site are adults, children and neonates, all buried mostly as extended supine inhumations, although some semi-flexed and one seated burial in a lotus position were also found (Borić 2006, 2007, 2011; Borić and Stefanović 2004; Radovanović 1996; Srejšević and Letica 1978:53–82). Cremations are also known from this site (Borić et al. 2009). A number of inhumation but also cremation burials contained ornaments.

Most of the ornaments to be discussed in the following text were found in Late Mesolithic burials excavated at Vlasac, most likely as part of body decoration embroidered on attire worn by the deceased. Our discussion is primarily focused on the corpus of ornaments associated with broadly contemporaneous (ca. 6700–6500 cal BC) burial 42a, excavated in 1970 (Borić 2003), and more recently excavated burials H2 and H297 (Fig. 4.2)—no other excavated burials in the Danube Gorges contained so many ornaments, namely cyprinid pharyngeal teeth and *Cyclope neritea* marine gastropod beads. Cyprinid (carp) teeth as body decoration represent the most abundant and representative form of local Late Mesolithic ornamental tradition and, for this reason, particular emphasis will be given to their analysis in this paper. They were also found

in burials excavated at the contemporaneous Late Mesolithic site of Schela Cladovei (Bonsall, 2008; Boroneanț, 1990), located some 80 km downstream from Vlasac, as well as in settlement deposits of Lepenski Vir (I. Živaljević, pers. comm.) and Kula (Fig. 4.1). At Schela Cladovei the maximum reported number of cyprinid teeth ornaments was 338 specimens for Burial M38 (Boroneanț 1990). But lower numbers of ornaments during older excavations in the region in comparison to those found during new excavations at Vlasac may well relate to the differing quality of recovery techniques between systematic and rescue excavations.

The repertoire of adornments from Late Mesolithic burials at Vlasac and Schela Cladovei is believed to be highly representative of the Late Mesolithic ornamental tradition of the region. In addition, apart from Vlasac, *C. neritea* beads have only been found in Epipaleolithic levels at Cuina Turcului (Mărgărit 2008:fig. 81; Păunescu 1970) and in an undated but possibly Late Mesolithic context at Ostrovul Banului (Mărgărit 2008:fig. 104). Precise contextual information available for the newly excavated burials at Vlasac made it possible to reconstruct the way ornaments were attached and arranged on clothing (Cristiani and Borić 2012; Cristiani et al. 2014b). In addition to the repertoire of ornaments recovered from burials, a wider picture of the Late Mesolithic ornamental tradition in the Danube Gorges is also enriched by ornamental beads

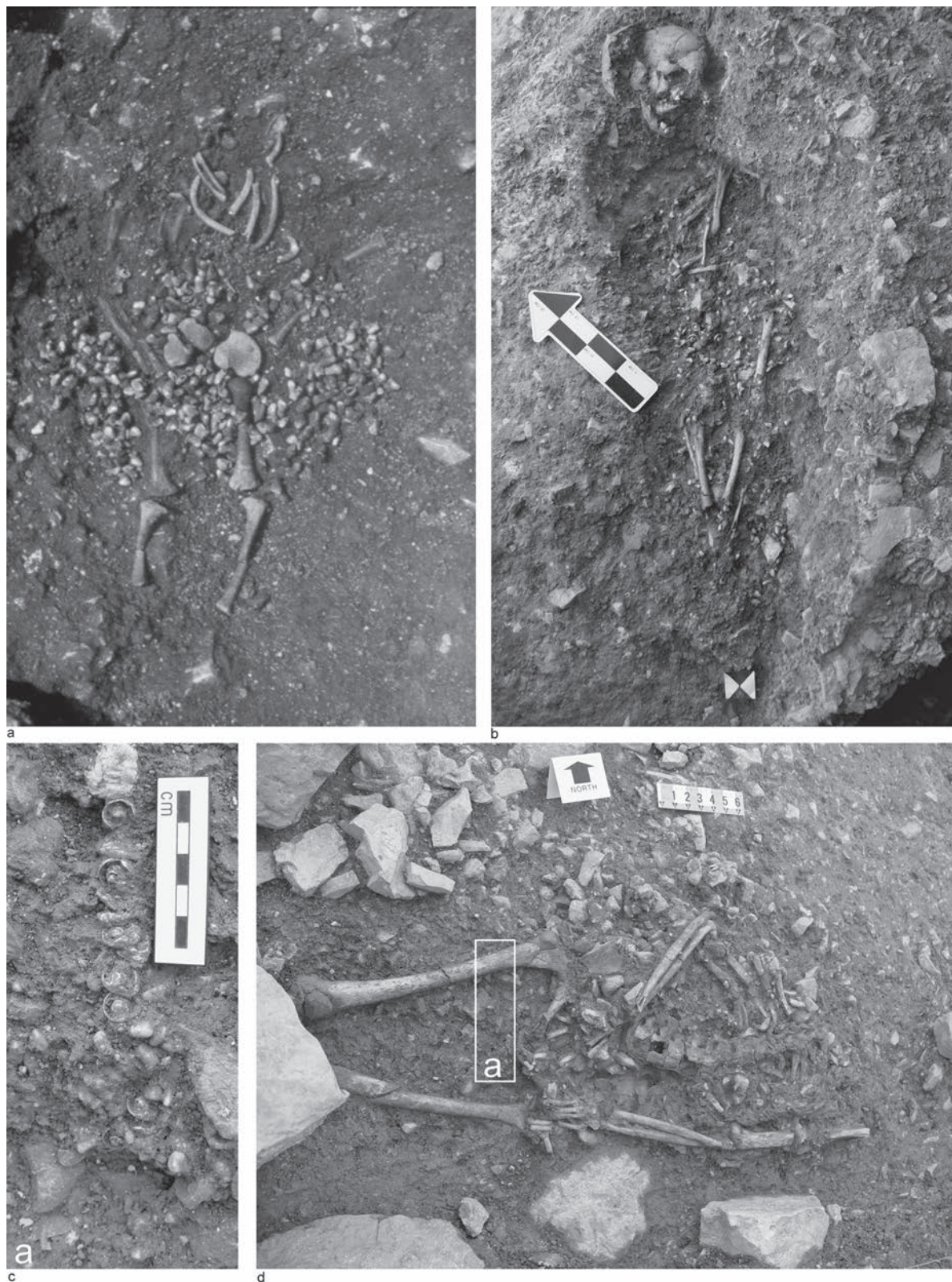


Figure 4.2 a. Burial 42a with cyprinid pharyngeal teeth ornamental beads around the pelvic area of the deceased infant (photo after Srejović and Letica 1978); b. Child Burial H297 from Vlasac with cyprinid teeth and Cyclope neritea ornaments found in situ upon exposing the burial (photo by Dušan Borić); c. Burial H2 from Vlasac with cyprinid and Cyclope neritea ornaments found in situ upon exposing the burial (photo by Dušan Borić).

recovered in settlement contexts during recent excavations at Vlasac.

Material

The 1970s excavations at Vlasac yielded a total of 1479 both perforated and unperforated ornaments made of cyprinid pharyngeal teeth, which represent the most numerous type of ornaments associated with Late Mesolithic burials at the site. In the course of new excavations, a total of 1817 Late Mesolithic ornamental cyprinid teeth were found. Cyprinid pharyngeal teeth represent the commonest material used as ornaments at Vlasac during the Mesolithic. These teeth occur in rows along the lower pharyngeal bones of cyprinid species (Edwards, 1929; Wheeler and Jones, 1989) (Figs 4.4c, 4.5b). They are constituted of an enamel globular body, which is attached to the pharyngeal bone through an elongated bony neck (Fig. 4.5a–b). Precise species identification can be difficult in the case of isolated teeth alone, such as those found as ornaments in burials at Vlasac. However, after a comparative analysis of isolated teeth and pharyngeal bones with still attached teeth found in contemporaneous settlement deposits at the sites of Lepenski Vir and Padina, partly contemporaneous with and found in the close proximity of Vlasac, we believe that the majority of teeth modified into or used as ornaments at Vlasac belong to a species of the genus *Rutilus* (Cristiani et al. 2014b) most likely *Rutilus meidingeri* Heckel, 1851 (Perlfisch, lake chub) or *Rutilus frisii* Nordmann, 1840 (vyrezub, kutum, Black Sea roach) (Fig. 4.4a–e). It could be of particular interest that perlfisch bears its name due to pearl-like tubercles on the head and back, characteristic of breeding males (I. Živaljević, pers. comm.). We shall come back to this point in our discussion.

There were also marine gastropod shells found in burials. Among these, 68 completely modified *Cyclope neritea* were identified from the collection excavated in the 1970s and 72 specimens were found in burials excavated from 2006 to 2009. *Cyclope neritea* Linnaeus 1758 is a species of marine gastropods that belongs to the family Nassariidae and is widespread in shallow waters of the Mediterranean, sandy shores of the Atlantic coast (e.g. in Portugal, Spain, and France) as well as in coastal lagoons and saltmarshes (Nordsieck 1968; Pérès and Picard 1964; Sacchi 1960; Southward et al. 1997). So far, no isotopic analyses have been carried out in order to define the geographical provenience of *C. neritea* beads found at Vlasac. Yet, the nearest available location for collecting such species of gastropods is at least 400 km away from the Danube Gorges, either toward the west in the Adriatic region (namely in the north-eastern coastal lagoons of north-eastern Italy) or to the east, at the confluence of the Danube river with the Black Sea). Dimensions of *C. neritea* ornaments from Vlasac have the following ranges: 9–14 mm in length, 7–12 mm in width, and a thickness of between 3 and 8 mm.

There were also eleven pierced *Columbella rustica* marine gastropods found during the 1970s excavations at Vlasac in a single burial, while another four pierced *C. rustica* were found in settlement contexts during the 2006–2009 excavations at the site. While, nowadays, *Columbella rustica* lives in warm waters and can be found on the coasts of the Mediterranean Sea as well as in the nearest parts of the Atlantic Ocean (Algarve in Portugal, northwestern Africa, the Canary Islands, the Azores, and Madeira) (Poppe and Goto 1991), no isotopic analysis has been carried out yet to confirm the exact provenience of *C. rustica* shells used as ornaments at Vlasac. The closest source for *C. rustica* is some 400 km from the site of Vlasac.

There were also pierced freshwater gastropod shells, namely three *Lithoglyphus naticoides* and three *Theodoxus danubialis*, found in settlement contexts during more recent excavations at the site (Tab. 4.1) (Fig. 4.3). *Theodoxus danubialis* is a common species in the rivers and streams of the Danube region and in the northern Alps. *Lithoglyphus naticoides* is distributed in the shallow waters of rivers and lakes in Central and Eastern Europe (Harzhauser et al. 2007; Mastitsky and Samilenko 2006), the Balkans and in the rivers of the Black Sea drainage basin (Radoman 1983). With the exception of the freshwater shells, ornaments recovered at Vlasac are all very well preserved.

Methodology

The methodology used for studying archaeological beads from Vlasac is based on the combination of technological, use-wear, residue, archaeozoological and taphonomic analysis, integrated with contextual, experimental and ethnographic information. Archaeological specimens have been examined using different types of microscopes: a stereoscopic microscope Leica 205C with LED lighting (magnification ranging from 10× to 165×), an incident light metallographic microscope Leica DM4000M with polarizing filters and bright and dark field (magnification from 50× to 1000× using) and an environmental SEM Hitachi T3000. Analytical criteria for interpreting technological features of Vlasac ornaments were established by reference to several publications on the use of shell and osseous beads found in prehistoric funerary contexts (e.g. Bonnardin 2007, 2009; d'Errico and Vanhaeren 2002; Vanhaeren and d'Errico 2001, 2003, 2005). Archaeological interpretations have been based on experimental comparison with a collection of modern unmodified and modified specimens of carp teeth and *C. neritea* and *C. rustica* marine shells. Taphonomic analysis of the archaeological ornaments have been based on the works of Claassen (1998), Driscoll and Weltin (1973) and d'Errico et al. (2005) whereas for the evaluation of fungal post-depositional alterations characterizing carp teeth and residues we refer to the works of Fisher (1995), Haslam (2004) and Hospitaleche et al. (2011).

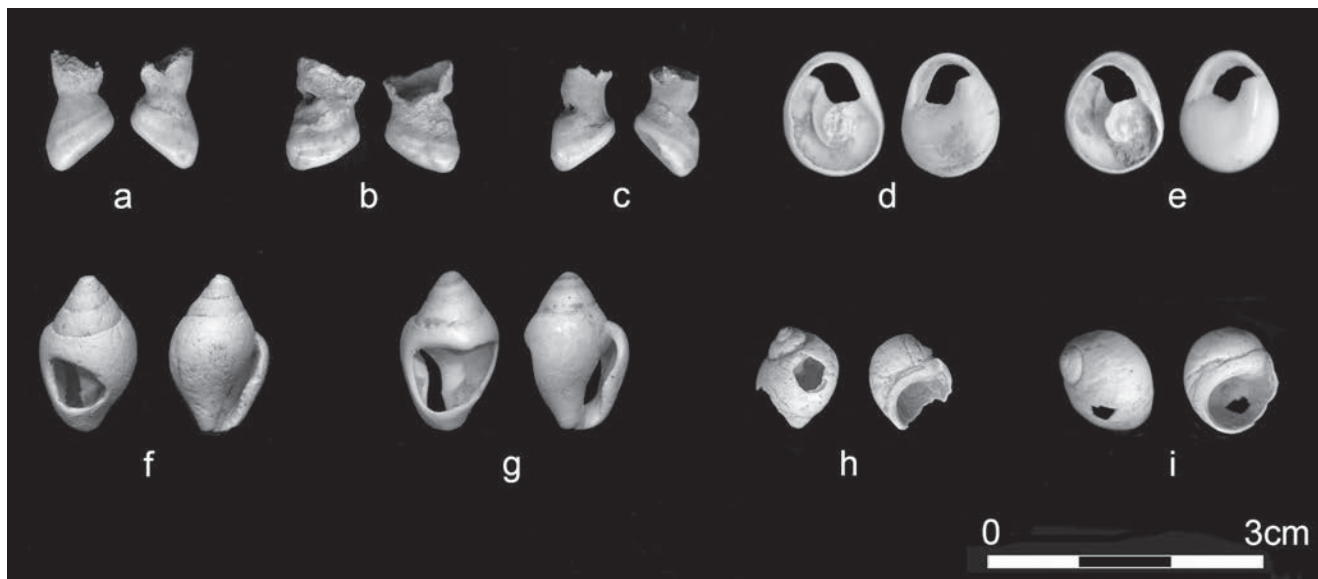


Figure 4.3 Selection of Late Mesolithic ornaments from Vlasac: 1. unmodified cyprinid tooth from Burial H2; 2–3. modified cyprinid teeth from Burial H297; 4–5. Cyclope neritea shell beads from Burial H2; 6–7. Columbella rustica perforated shells from US308; 8–9. Lithoglyphus naticoides from US47 (photos by Emanuela Cristiani).

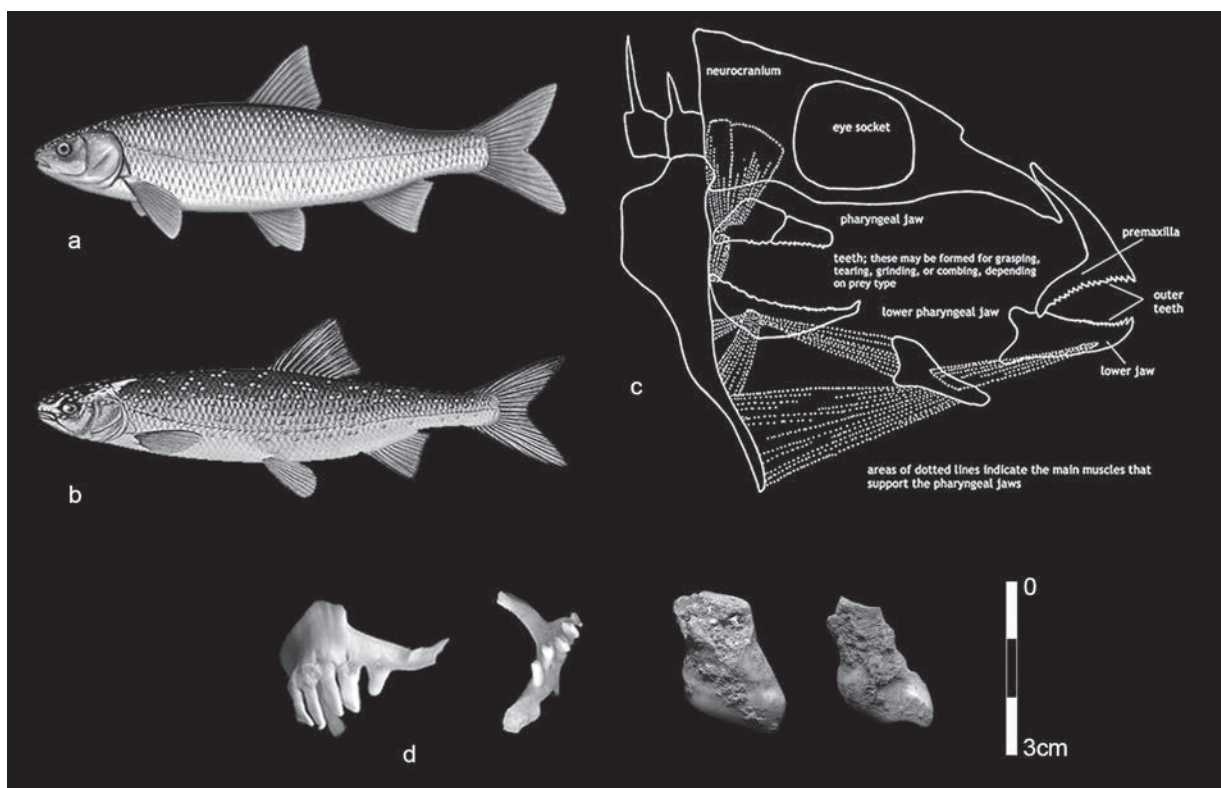


Figure 4.4 Cyprinid pharyngeal teeth, species identification: a. Vyzub, kutum (*Rutilus frisii*); b. Perlfisch (*Rutilus meidingeri*); c. Anatomy of cyprinid neurocranial, branchiocranial and pharyngeal bones; d–g. Comparisons between a recent *Rutilus rutilus* pharyngeal bone – d. ventral view and e. dorsal view (photos by Ivana Živaljević) – with two ornamental *Rutilus* sp. pharyngeal teeth from Burial 42a (photos by Emanuela Cristiani).

Table 4.1 Shell ornaments found at the site of Vlasac (excavations 1970–1971 and 2006–2009).

Burial no./context	Context description / burial type	Sex	Age	Cyprinid teeth	<i>C. neritea</i>	<i>L. naticoides</i>	<i>T. danubialis</i>	<i>C. rustica</i>
Burial contexts (1970–1971 excavations)								
14	Sq. B/IV, ly. 1 (13/10/1970), inv. 204a	Female	Adult	53	—	—	—	—
21	Hearth 4 (16/10/1970), inv. 223a; cyprinid teeth in the stomach area; <i>C. neritea</i> beads in the rib cage area	?	Infant	119	50	—	—	—
29	Hearth 2, sq. A/II, ly. 16 (26/10/1970), inv. 347b, red ocher on hand and leg bones; cyprinid teeth in the pelvic area	Female	Adult	93	1	—	—	—
31	Habitation 2, sq. a/17, ly. 23 (29/10/1970); cyprinid teeth around the left hand and in the pelvic area	Male	Young Adult	Info not available	15	—	—	—
42a-b	Habitation 2, below stone construction V, sq. b/13, ly. 12 (30/06/1971), inv. 469; cyprinid teeth in the pelvic area	?	Infant	288	—	—	—	—
45a	Cyprinid teeth mixed with charred human remains found next to the skull of articulated Burial 45	?	Adult	410	—	—	—	—
46	Cyprinid teeth in the pelvic area	Female	Old Adult	226	—	—	—	—
47a	Sq. A/17; cyprinid teeth mixed with charred human remains found next to the skull of articulated Burial 47	?	Adult	25 (1 burnt)	—	—	—	—
49	Inv. 592; cyprinid teeth in the pelvic area, <i>C. rustica</i> next to the hand bones covering the pelvis	Female?	Adult	67	—	—	—	11
50a	Inv. 552c, b; cyprinid teeth below the pelvic area	Male?	Adult	52	—	—	—	—
60	Cyprinid teeth below the pelvis area	Male	Adult	Info not available	—	—	—	—
62	Covered with red ocher	?	Infant	Info not available	—	—	—	—
74	Cyprinid teeth in the pelvic area	Female?	Adult	60	1	—	—	—
78a	Cyprinid teeth in the pelvic area	Female	Adult	7	1	—	—	—

(Continued)

Table 4.1 Shell ornaments found at the site of Vlasac (excavations 1970–1971 and 2006–2009). (Continued)

Burial no./context	Context description / burial type	Sex	Age	Cyprinid teeth	C. neritea	L. naticoides	T. danubialis	C. rustica
Burial contexts (2006–2009 excavations)								
H2	Primary	Female	Around 40 y	642	32	–	–	–
H81	Primary/secondary	Male	Around 40 y	1	–	–	–	–
H232	Primary	Female	Around 25 y	27	–	–	–	–
H244	Primary/secondary/ cremation	Female	30–40 y	–	1	–	–	–
H254	Primary	Male	30–50 y	1	–	–	–	–
H267	Primary	Female	Around 50 y	251	–	–	–	–
H297	Primary	?	1 y	701	22	–	–	–
H317	Primary	Female	Around 30y	–	–	1	–	–
H326	Primary	Male	Around 50 y	1	1	–	1	–
H321	Disturbed/ Secondary	?	Adult (?)	–	–	–	1	–
54	Cremation (34 burnt bone frags. weighing 14.1 g)	n/a	Adult (?)	13	–	–	–	–
87	Cremation (8 burnt bone frags. weighing 1.8 g)	n/a	Adult (?)	29	–	–	–	–
110, 115	Cremation (1052 burnt bone frags. weighing 769 g)	n/a	Adult (?)	55	1	–	–	–
242, 261 (F. 23)	Cremation (468 burnt bone frags. weighing 158.4 g)	n/a	Adult (?)	1	10	–	–	–
Settlement contexts (2006–2009 excavations)								
47	Layer/colluvial deposits, Sq. 94/96 (21), T. 3/2006 (04/06/2006)	n/a	n/a	–	1	1	–	–
94	Layer/colluvial deposits, T. 3/2006 (10/07/2006)	n/a	n/a	–	1	–	–	–
138	Layer, colluvial deposits, T. 3/2006 (19/07/2006)	n/a	n/a	–	–	–	1	–
228	Fill of a pit feature, T. 1/2007, x.27 (22–27/05/2008)	n/a	n/a	–	–	–	–	1
239	Layer/colluvial deposits, T. 3/2007 (25/05/2007)	n/a	n/a	–	1	–	–	–
264	Layer/colluvial deposits, T. 3/2007 (22/06/2007)	n/a	n/a	–	1	–	–	–
282	Finds concentration, T. 3/2006 (01/07/2007)	n/a	n/a	–	–	–	–	1
308	Layer/colluvial deposits, T. 3/2007 (20/05/2008)	n/a	n/a	–	1	1	–	1
314	Fill of a pit/dwelling feature, T. 1/2007	n/a	n/a	–	–	–	–	1
Total				3122	140	3	3	15

Fish archaeozoological determination of cyprinid teeth species was based on the comparison with isolated teeth and pharyngeal bones with still attached teeth found in contemporaneous settlement deposits at the sites of Lepenski Vir and Padina, which neighbor Vlasac as well as with available literature (Cristiani et al. 2014b; Kottelat and Freyhof 2007:246–248; Ristić 1977:62–63; Simonović 2001:174–176).

Residues were observed and studied along with use-wear analyses in order to better define the system for suspension or attachment of ornaments to clothing and/or to identify material used for sewing or suspending them. Residues were interpreted *in situ* on the basis of their morphological features. The elemental composition of residues on carp teeth was characterized by Energy Dispersive X-ray Spectroscopy (EDXS) analysis as well as through Fourier Transform Infrared Spectroscopy (FTIR). Morphology and quality appearance of residues was evaluated with reference to several authors whose work has focused mainly on stone tool residue analyses (e.g. Barton et al. 1998; Fullagar 1998, 2006; Hardy and Garufi 1998; Kealhofer et al. 1999; Lombard 2004, 2005, 2007; Lombard and Wadley 2007; Piperno and Holst 1998). Also, one of us (EC) built an experimental reference collection composed of modern, completely modified *C. neritea* shells as well as bone ornaments, which were embroidered on leather using hide, sinew and linen strings. Additionally, EC analyzed various kinds of ethnographic ornamental objects in the form of shell, bone and teeth necklaces, bracelets, necklaces, wristlets, a wampum as well as an ornamented quiver curated by the Museum of Archaeology and Anthropology (MAA) in Cambridge, England. These objects come from hunter-gatherers of North America, such as the Plains Indians, Arctic Eskimos as well as foragers of Papua New Guinea (southeast coast Papuans) (Cristiani et al. 2014b). Experimental and ethnographic comparisons were key in reconstructing modes and materials of Mesolithic ornaments' use and suspension at Vlasac.

Results

In the following, the results of our technological, use-wear, and residue analyses carried out on cyprinid pharyngeal teeth, *C. neritea*, *C. rustica*, *T. danubialis*, and *L. naticoides* ornaments found in both burial and settlement contexts are presented for each category of ornament.

Cyprinid Pharyngeal Teeth Appliqués

We have made detailed, integrated analyses of cyprinid teeth ornaments that come from three burials found at Vlasac: two of these burials (H2 and H297) have the largest number of cyprinid teeth ornaments out of all known burials from the Danube Gorges and were excavated in 2006 and 2007

respectively, while the third burial (42a) was excavated in 1970. Ornaments found in these three burials can be taken as a representative sample for all other cyprinid teeth ornaments from other burials found at Vlasac. A total of 642 perforated and unmodified cyprinid teeth were associated with a 30–40-year-old woman in Burial H2, there were 701 perforated and unmodified cyprinid teeth associated with the infant in Burial H297, and 288 unmodified cyprinid teeth were found with the infant in Burial 42a. Cyprinid teeth were found over, around, and underneath the body of the deceased (Cristiani and Borić 2012) (Figs 4.3, 4.5a). Most of the teeth were found securely beneath the body of the deceased, which makes it likely that most of these ornaments were associated with/worn on the back rather than the front of the body. The highest frequency of cyprinid teeth ornaments was encountered beneath and around the pelvis of the deceased, more precisely beneath the thigh bones and torso (Fig. 4.5). This distribution has been recorded precisely for Burials H2 and H297 (Cristiani and Borić 2012). It could only be assumed for Burial 42a.

Our experimental activity has shown that pharyngeal teeth were extracted from the jaw through flexion (Fig. 4.6c). Once removed, teeth were used either without further modification or were turned into ornaments by cutting out a transversal perforation in the frontal part of a tooth (Fig. 4.6d–e). Developed use modifications on both perforated and unmodified teeth reveal their use as appliqués embroidered on clothing. On perforated teeth, rounding is developed on the frontal part of the upper extremity, both outside and inside (Fig. 4.7a–c), on one of the sides, around the fracture edge (Fig. 4.7d) and on the upper part of the hole where striations are also present (Fig. 4.7b, e–g). On unmodified teeth compression marks and rounding are located all around the neck while striations have been identified on the frontal and the lateral sides of teeth (Fig. 4.7h–i).

Residues identified on ornamental teeth from Burial 42a, H2, and H297 can be described as thick fibers and reddish pasty compound on the basis of their morphological appearance. In particular, thick white-yellow birefringent fibers have been documented on 847 cyprinid pharyngeal teeth out of 1631 specimens, which is the total found in Burials 42a (Fig. 4.4e), H2, and H297. These filaments appear in the form of thick, elongated and elastic fibers with a maximum length of ca. 700 µm and a maximum width of ca. 300 µm (Fig. 4.8a–c). Fibers mostly show a rectangular-flat/oval section, a bundle-like internal composition and are located around the neck of the ornaments with a horizontal/slightly oblique orientation with regard to the longitudinal axis (Figs 4.8a–c, 4.9a). On perforated teeth, fibers were found also inside the hole. Sometimes up to two or three thick fibers were recorded on the same tooth specimen (e.g. Fig. 4.9b). By comparison with experimental and ethnographic reference collections, the morphological features of archaeological fibers were attributed to animal sinews (Fig. 4.10a–f).

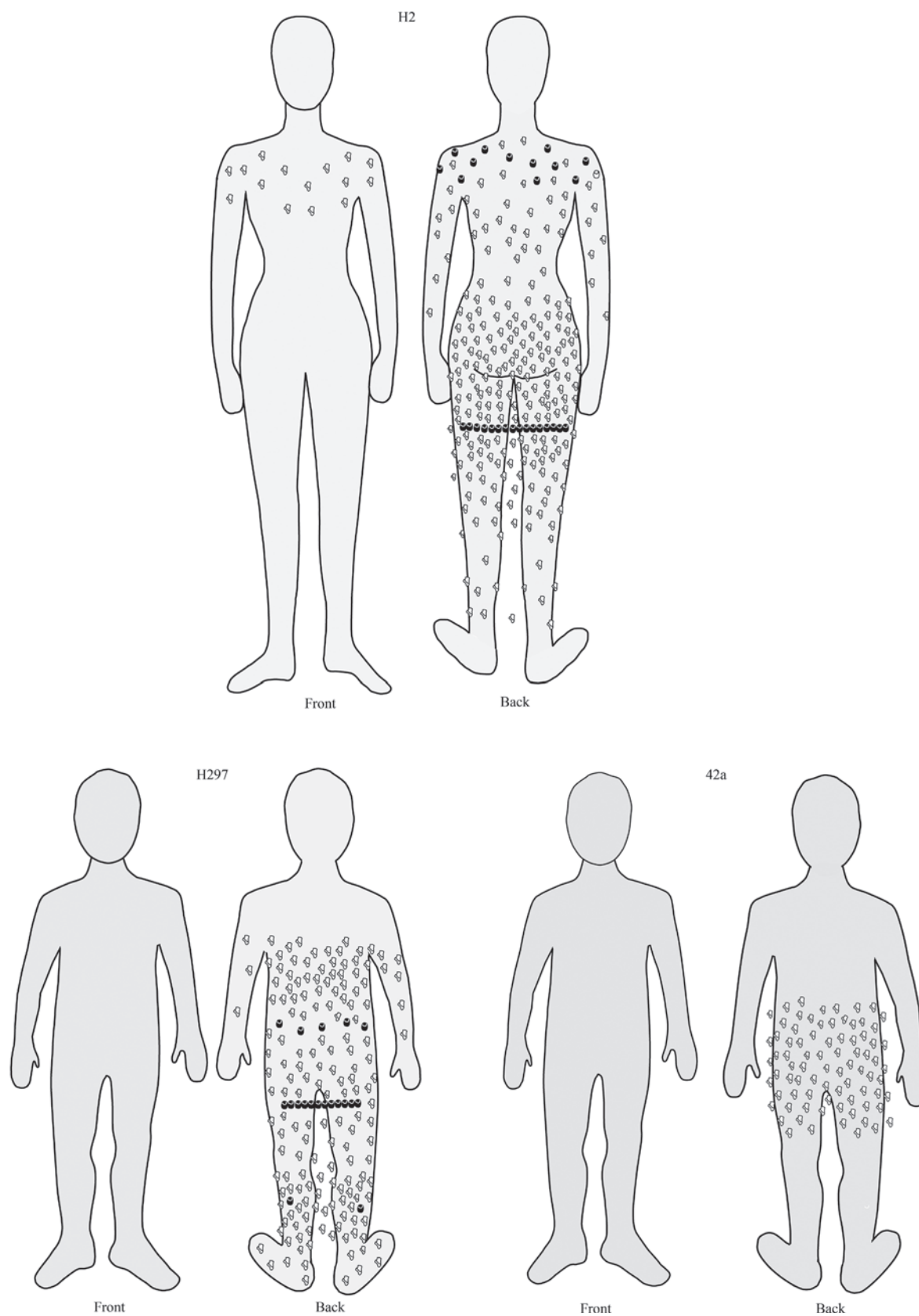


Figure 4.5 Reconstruction of the patterning of carp teeth and Cyclope neritea ornaments on Late Mesolithic Burials H2, H297 and 42a (drawing by Emanuela Cristiani and Dušan Borić).

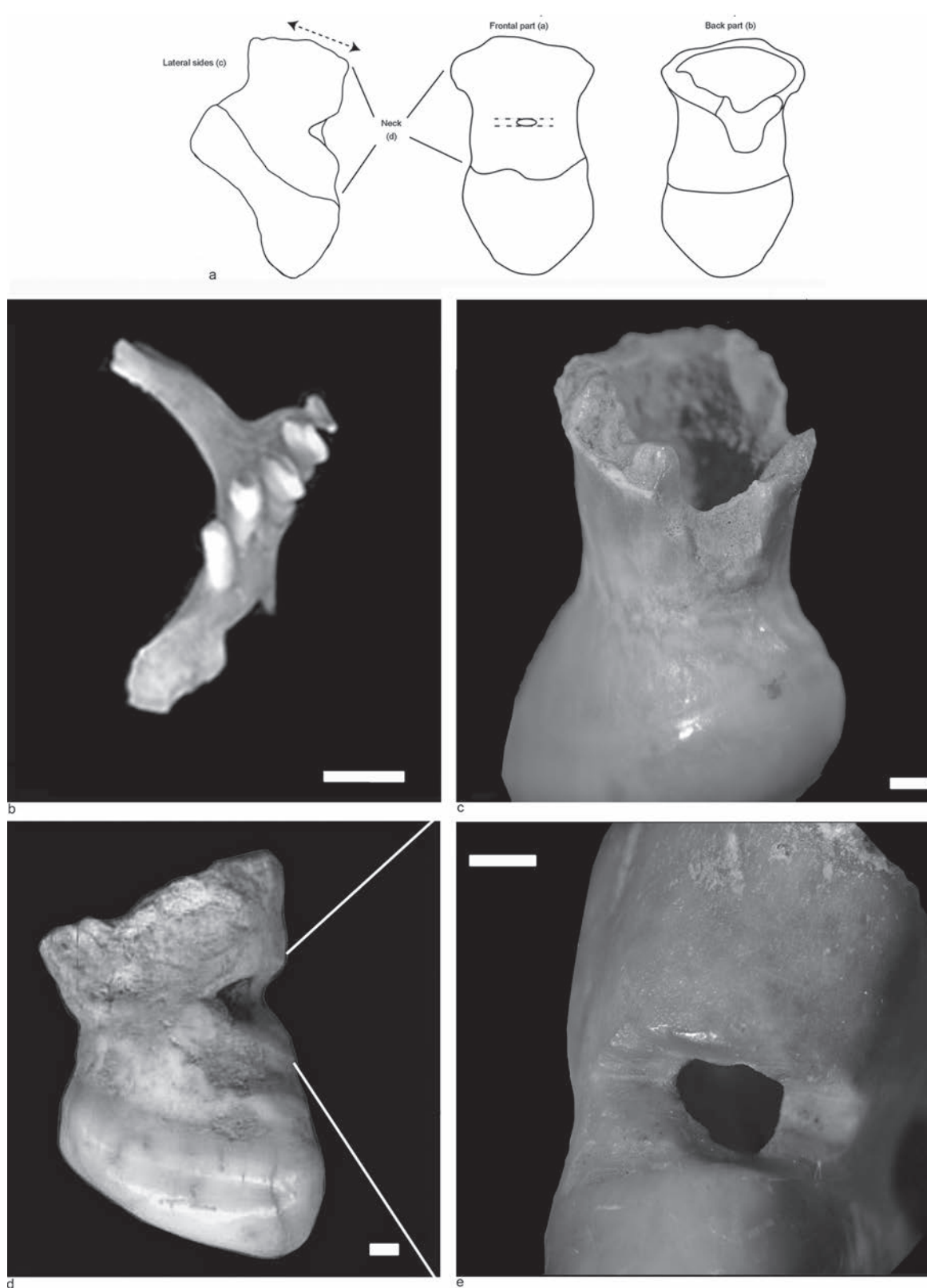


Figure 4.6 Technological traits of carp teeth ornament modification: a. profiles of a modified *Rutilus* tooth; b. Dorsal view of a modern *Rutilus rutilus* pharyngeal bone and teeth (photos by Ivana Živaljević), scale bar = 1 cm; c. typical fracture on the neck of a perforated tooth from Burial H2, scale bar = 1 mm; d. perforated tooth from Burial H297, scale bar = 1 mm; e. front detail of the perforation with sawing marks, scale bar = 1 mm (drawing and photos by Emanuela Cristiani).

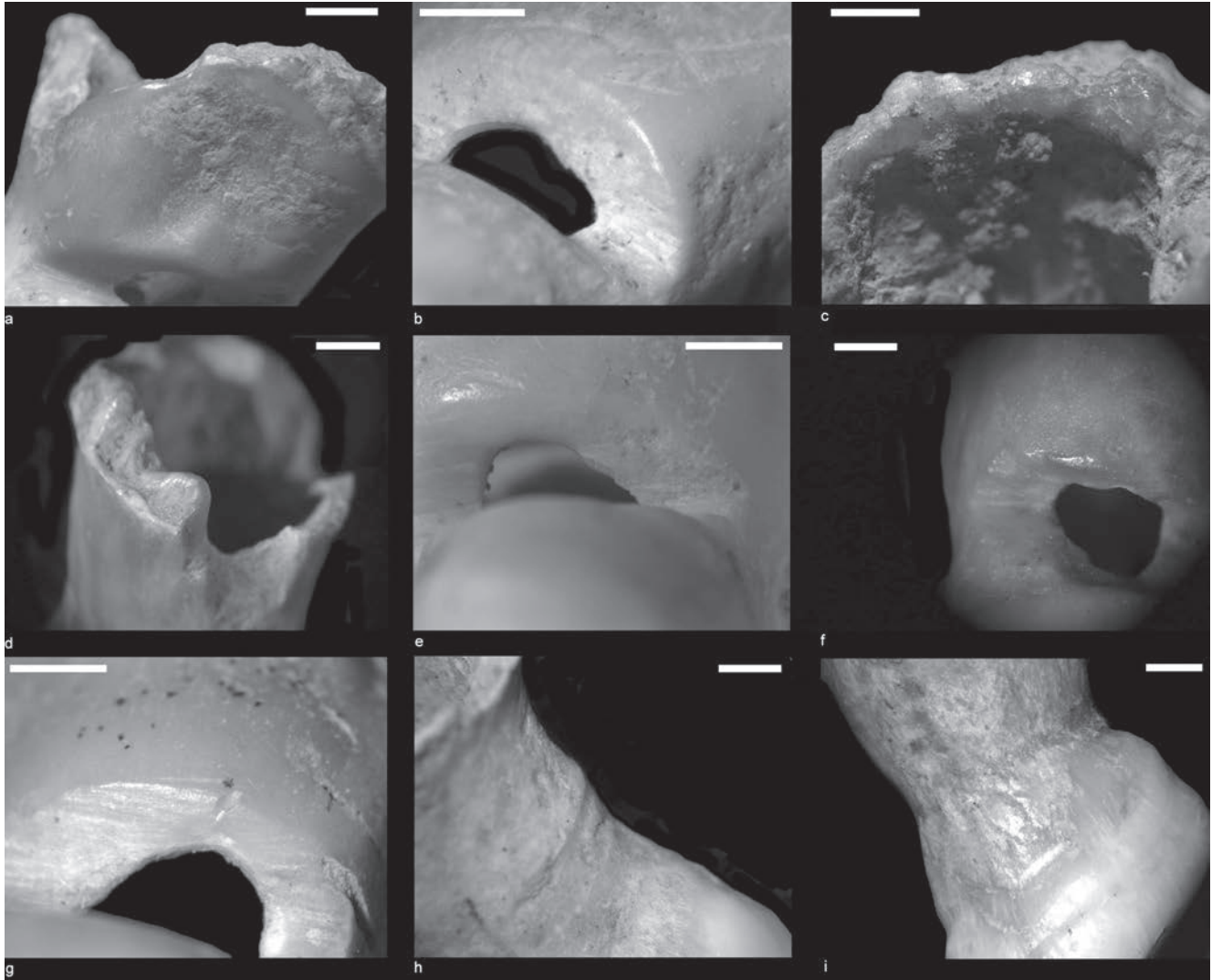


Figure 4.7 Typical use-wear traces on carp teeth ornaments: a. rounding on the front of a perforated tooth, scale bar = 1 mm; b. rounding inside the hole and on the front part of a perforated tooth, scale bar = 1 mm; c. rounding inside the fracture edge of a perforated tooth, scale bar = 1 mm; d. developed rounding on the fracture edge of a perforated tooth ornament, scale bar = 1 mm; e. rounding and deformation inside the perforation hole, scale bar = 1 mm; f. rounding outside the perforation hole, scale bar = 1 mm; g. the arrow shows traces of compression around the back of the neck, scale bar = 1 mm; i. the arrow shows traces of compression around the side part of the neck, scale bar = 1 mm (photos by Emanuela Cristiani).

Fibers are generally enclosed in a compound, which evidently covers them (Figs 4.8a–f, 4.9e–f). Pasty concretions have been identified on 387 out of the total of 1631 specimens from Burials 42a, H2, and H297, which have been analyzed for residues. These residues are generally located around the neck, less frequently on the upper part of their prominent enamel extremities and inside the cavity of the teeth. When concretions are well preserved, their surfaces appear flattened indicating that the compound might have been modelled around the neck of the teeth to secure the fastening system (Figs 4.7d–e, 4.8b–d). At high magnification (100×–1000×) and using a polarizing filter, the compound shows an intense proliferation of fungal spores, often disposed in

chain formation, suggesting a possible organic nature of the reddish compound (Haslam 2004) (Fig. 4.9f). This hypothesis is supported by the results of the EDXS and FTIR spectra of the concretions (Cristiani et al. 2014b), which respectively show intense carbonaceous lines (Fig. 4.11a–c) and typical absorption lines corresponding to the C–H group (Fig. 4.11d). As the latter is one of the most common groups in all organic molecules, on the basis of our data it is not possible to be more precise about the specific nature of the organic compound. The intensity of use-traces on cyprinid teeth from two different research phases at Vlasac suggest that these ornaments were worn over a considerable period of time before being deposited in these burials.

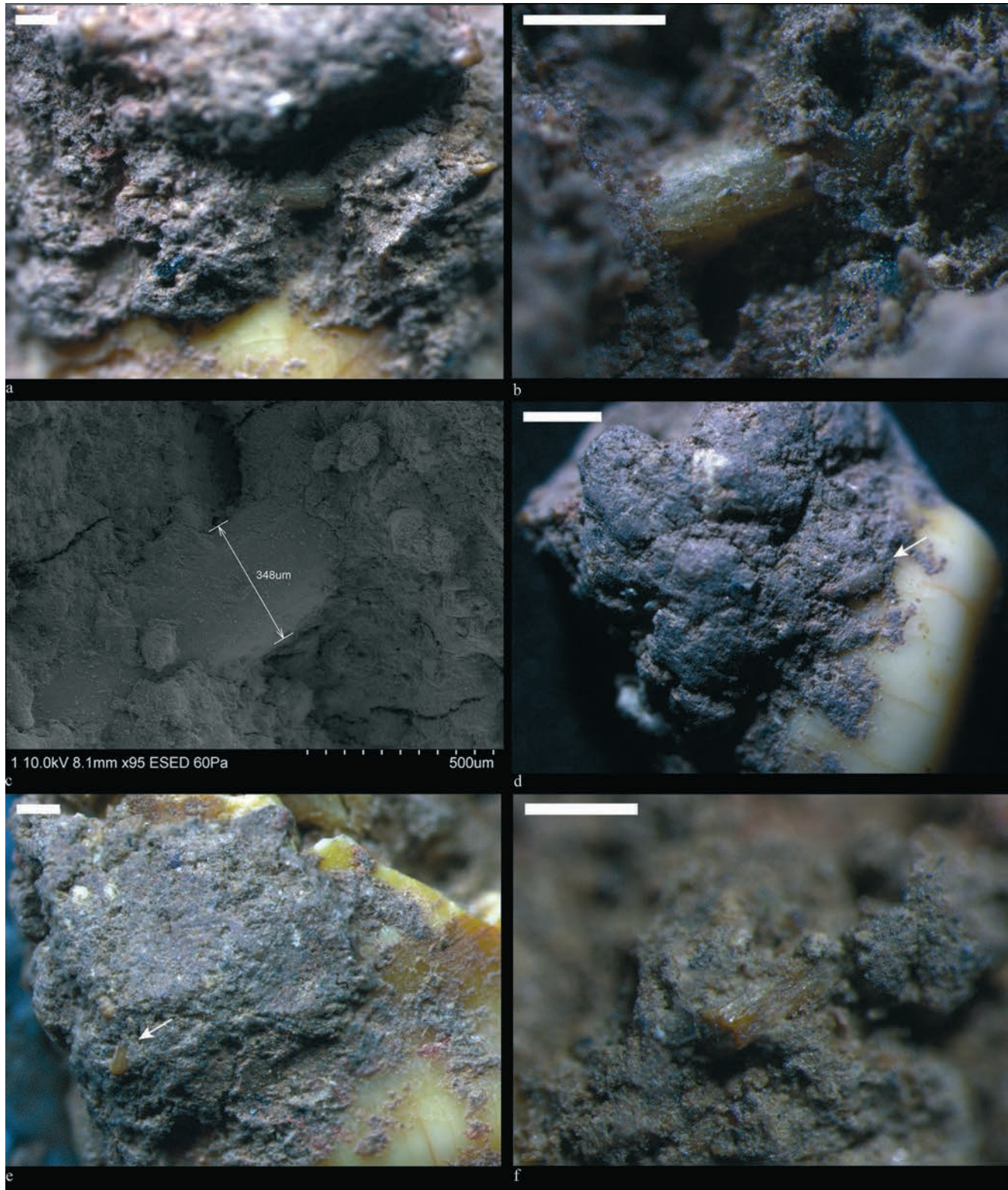


Figure 4.8 Fibers of sinews identified on unmodified cyprinid pharyngeal teeth from Burial 42a: a. thick fiber with horizontal/slightly oblique orientation with regards to the longitudinal axis of the teeth. Notice how the fiber is embedded in the reddish concretion, scale bar = 0.5 mm; b. close-up of the same fiber, scale bar = 0.5 mm; c. SEM image of the same fiber with metrical information; d. thick fiber on another unmodified tooth showing modelled paste-like reddish concretion, scale bar = 1 mm; e. another example of modelled paste-like concretion on another unmodified tooth, scale bar = 0.5 mm; f. fiber characterized by a bundle-like internal composition, scale bar = 0.5 mm (photos by Emanuela Cristiani).

Cyclope neritea

Mesolithic *C. neritea* ornaments from Vlasac are technologically modified in order to appear as homogeneous white beads with a large hole beneath the lip of the shell (Fig. 4.3d–e). In particular, the technique used for processing archaeological *C. neritea* beads involved the removal of the main colored whorls with the exception of the last body whorl. Also, the last two internal spirals of the shell are generally absent. A comparison of experimental and archaeological specimens suggests that the modification of the shells started from the production of keyhole perforation by pressure exercised from the inside to the outside of the shell. Micro-chipping is, in fact, visible on the outer surface of the perforation. The micro-chipping identified on the whorl edges of the archaeological *C. neritea* beads as well as the notched outline that characterizes the outer spiral left on the specimens, indicate that the convex side of the shell was removed by pressure carried out toward the inside of the shell, all along the body whorls (Fig. 4.12a–b) and toward the outside (for the removal of the shell apex, see Fig. 4.12c–f). The possibility that taphonomic alteration (e.g. decalcification or sediment abrasion) might have caused the actual aspect of the *C. neritea* is excluded on the basis of the overall good preservation of the ornaments from *C. neritea*, which are characterized by very thick walls and rounded and worn edges. Furthermore, neither small perforations corresponding to different stages of natural erosion are visible on the tips of the shells or on their bases and lateral areas of the convex surfaces (as documented on a number of modern shells) nor has pitting been identified on the shell apex or on any other surfaces, as would be expected from sedimentary abrasion (see Driscoll and Weltin 1973).

Use-wear traces are very developed on the examined *C. neritea* shells, hinting at the use of these ornaments for a considerable period of time before their deposition. We could assume that such an intense pattern of wear stems from the fact that the ornaments were worn on a daily basis in the course of an individual's lifetime, were passed down several generations, or both. Functional traces are located on the upper side of all *C. neritea* shell beads. In particular, the edges of the shell whorls are rounded and polished (Fig. 4.13a), while the internal spiral, which is left from the technological removal of the apex, shows flat facets (Fig. 4.13c). Similar traces are also visible on the prominent part of the shell close to its lip (Fig. 4.13b) and on both sides of the lip (Fig. 4.13d–e). Residues, namely red ochre concretions, have been identified only on *C. neritea* ornaments from Burials 21, 31 and 42a, which come from the 1970–1971 excavations at Vlasac.

New excavations at Vlasac provide key information about the distribution of *C. neritea* beads in relation to the body. In particular, in both burials H2 and H297 *C. neritea* shells were found in a similar position, i.e. as a horizontal, linear string of beads below the proximal half of the femora of

these individuals with the flat, ventral side of the shell facing down. A few *C. neritea* beads were also found underneath the torso as well as below the legs of the deceased (Cristiani and Borić 2012).

Columbella rustica

C. rustica beads from Vlasac were all pierced by inserting a (wooden) stick inside the mouth of the shell and applying gentle pressure (Fig. 4.14a–c). All of the specimens were used for a prolonged period of time. The perforation edges are heavily worn and a significant development of rounding is recorded on the upper part of the hole while the inner side of the lips shows flat facets due to the contact with a string used for suspension. The reported position of 11 specimens found in Burial 46 suggests that these were found in proximity to the hand bones of the deceased covering the pelvis, and we may assume on the basis of this contextual information that they were attached to some sort of string or sewn onto the clothing of the deceased on their front part. Since this is the only burial from Vlasac associated with *C. rustica* beads together with cyprinid teeth ornaments, it is of interest to note that this adult individual, a possible female, is one of only two among 46 individuals measured for strontium isotopes who exhibits a non-local signature, suggesting that this individual was not born in the Danube Gorges but elsewhere (Borić and Price 2013). If this association is not coincidental, one may assume that the association of *C. rustica* beads with this individual underlines her foreign origins. Four specimens found in the course of more recent excavations at the site were all found in settlement contexts that are dated to the early seventh millennium cal BC. The contexts in which *C. rustica* were found during the new excavations at Vlasac have been dated to the Late Mesolithic, before the appearance/popularity of *C. neritea* beads (Borić et al. 2014).

Theodoxus danubialis and *Lithoglyphus naticoides*

Examples of beads produced with *T. danubialis* and *L. naticoides* from Vlasac show an overall poor state of preservation. These shells were perforated by pressure, inserting a (wooden) stick inside the mouth of shell (Fig. 4.14d–f). Use-wear traces preserved on one archaeological specimen suggest the use of this category of ornaments as appliqués. These likely ornamental beads made of freshwater shells were found in settlement contexts only.

Discussion

There are some types of ornaments in the repertoire of Mesolithic ornaments found at the site of Vlasac in the Danube Gorges that fit the Epipaleolithic and Mesolithic long-term forager regional traditions of body decoration characteristic of Southern Europe, i.e. the Balkans and Italy in particular (e.g. Cristiani 2013; Mărgărit 2008). The best

example of this is the appearance of marine gastropod shells *C. rustica* and freshwater species such as *T. danubialis*, and *L. naticoides*.

As far as *C. neritea* ornaments are concerned, they have often been found in Epipaleolithic burial and settlement deposits in both Italy and the Balkans (e.g. Cristiani 2013; Douka et al. 2011; Fiocchi 1998; Gurioli 2006; Mărgărit 2008). This type of ornament reappeared in Late Mesolithic contexts at Vlasac, where they were primarily found in burials. *C. neritea* beads were also found in a settlement context at the site of Ostrovul Banului on the Romanian side of the Danube Gorges area. Furthermore, the described technological characteristics of these shells point to very specific ways of appropriating the given raw material through a complete modification of such shells. This is specific to the examples of *C. neritea* found in Late Mesolithic contexts of the Danube Gorges. This particular trait reveals that while the long-distance circulation and use of this type of shell might have been driven by common, socially embedded values shared by very distant communities of southern Europe who appreciated these materials, in the course of the Late Mesolithic, the forager communities in the Danube Gorges developed their own culturally unique means of making and using these ornamental beads. Hence these beads can be seen as an element of a shared symbolic syntax over a very wide area.

These common southern European Mesolithic ornamental “codes” identified at Vlasac and contemporaneous sites in the Danube Gorges can be contrasted with certain elements that developed in the course of the Late Mesolithic in this region, which make this ornamental tradition relatively unique. This point refers to the use of cyprinid family fish species pharyngeal teeth on their own or in combination with *C. neritea* marine shells that were unambiguously worn on some type of clothing. The lack or paucity of other Mesolithic burials with ornaments in the Balkans and Italy make these instances from the Danube Gorges our only source of information about the attire worn by the deceased in Late Mesolithic communities. The use of cyprinid teeth constitutes a key trait of the ornamental tradition not only at Vlasac but it seems also in the whole of the Danube Gorges region based on the fact that hundreds of these ornaments were also found associated with Late Mesolithic burials at the site of Schela Cladovei on the Romanian bank of the river (Boroneanț 1990). To-date, in this region, cyprinid teeth specimens turned into ornaments have also been reported in burials at the site of Kula (Radovanović 1996) and in trapezoidal buildings at Lepenski Vir (I. Živaljević, pers. comm.). However, no other excavated burials in the Danube Gorges contained as many cyprinid teeth as Burials 42a, H2, and H297 at Vlasac. At Schela Cladovei, the maximum reported number of cyprinid teeth was 338 specimens for Burial M38 (Boroneanț 1990, 2001), although we cannot be sure whether these differences are due to the

quality of recovery techniques applied in the course of earlier rescue excavations in the region.

A particular enigma regarding the distribution of cyprinid teeth is presented by a suite of sites in southern Germany, found in the Upper Danube region, where cyprinid teeth were also found used as ornaments, albeit in smaller quantities. Such ornaments were reported for the site of Burghöhle von Dietfurt (Baden-Württemberg, Germany), Fälkenstein Höhle (Bavaria, Germany), Probsttals (Baden-Württemberg, Germany) and Hohlenstein-Stadel (Baden-Württemberg, Germany) (Rigaud 2011; Rigaud et al. 2014; see also Rähle 1978; Völzing 1938; Wetzel 1938) (Fig. 4.15). At the site of Hohlenstein-Stadel, these ornaments were associated with a secondary burial containing several disarticulated skulls, and might have been attached to some sort of headdress worn by the deceased (Fig. 4.16a). These two regions are some 1,000 km apart as the crow flies and even more distant if one travels along the Danube course. Moreover, there are no other known Mesolithic sites between these two regions with cyprinid teeth ornaments.

On the basis of the presence of ornaments on *Rutilus* pharyngeal teeth along the Upper Danube, Newell et al. (1990) hinted at the existence of a “Fish Teeth Band” or “*Rutilus* band” in this region. The archaeological evidence from Vlasac and other sites located along the Danube Gorges would extend this ornamental tradition to the Lower course of the Danube River. Moreover, at Vlasac and Hohlenstein-Stadel, where detailed analyses of ornaments have been conducted, fish of the same genus of the cyprinid family (*Rutilus*) seem to have been exclusively used for extracting pharyngeal teeth for ornamental bead-making among other available cyprinid species. Yet, one should also note differences between the two regions in the use of cyprinid teeth as ornaments.

Firstly, there are differences in other types of ornaments apart from cyprinid teeth used in the Danube Gorges and the Upper Danube Region. In the Danube Gorges, apart from cyprinid teeth ornaments, the most prominent are beads made from the marine gastropod *C. neritea* as well as freshwater gastropods such as *L. naticoides* and *T. danubialis*, while beads made from the marine gastropod *C. rustica* are only occasionally found. With the exception of *C. neritea*, which were found in Upper Paleolithic/Epipaleolithic deposits in the Balkans (e.g. Douka et al. 2011; Mărgărit 2008), all the other species were widely diffused as part of a primarily Mesolithic ornamental tradition in southern Europe (e.g. Cristiani 2013; Cristiani et al. 2014a; Komšo and Vukosavljević 2011). In the Upper Danube region, cyprinid teeth are associated with a very different repertoire of ornaments which included red deer canines, fossil gastropods (*Gyraulus sulcatus* and *Gyraulus trochiformis* and *Potamides laevis*), fox canines and, also, the marine gastropod shell *C. rustica* (Rigaud 2011). Hence the two regions can hardly be said to belong to

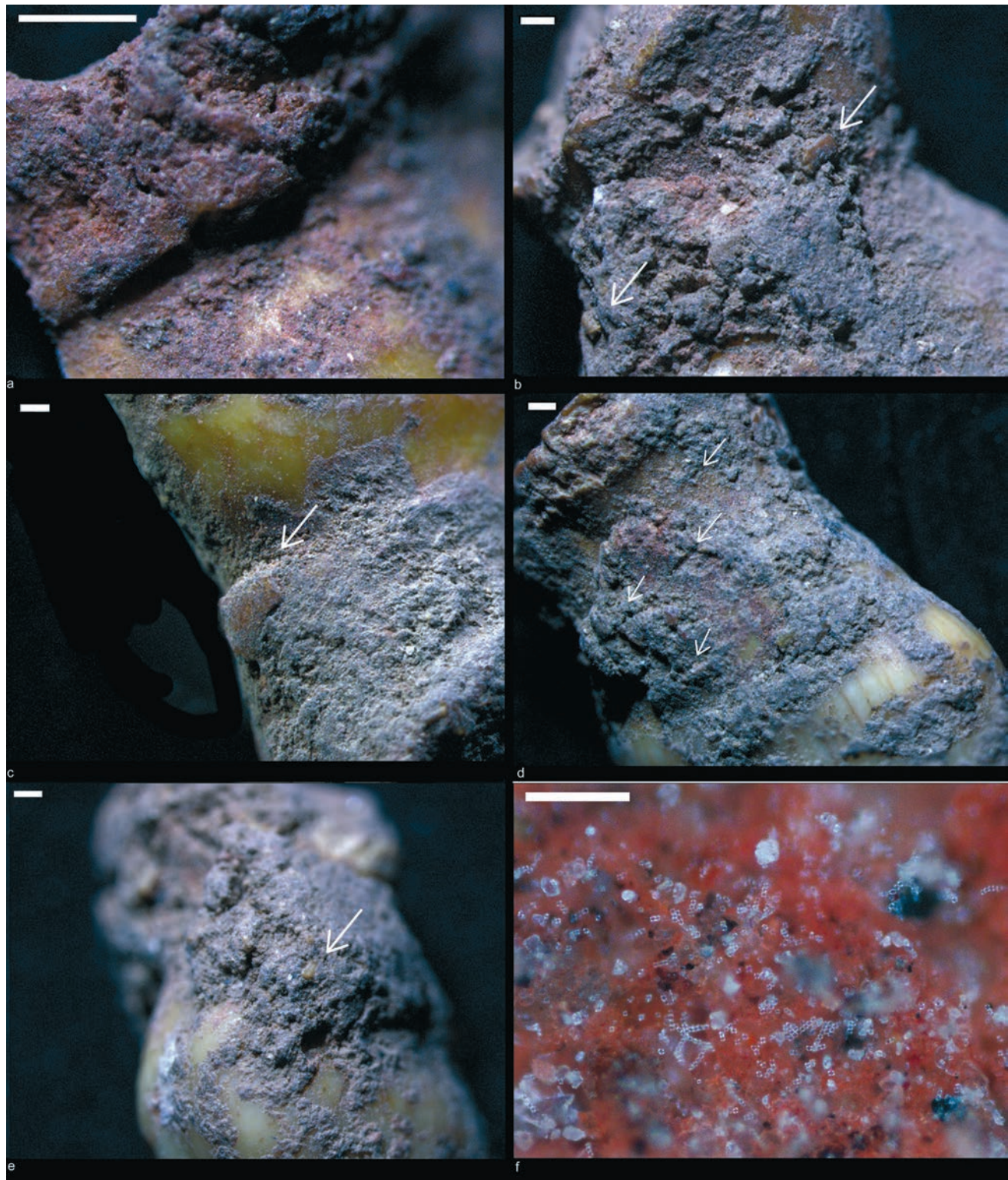


Figure 4.9 Fiber residues on various unmodified cyprinid pharyngeal teeth from Burial 42a showing their position and orientation on ornaments: a. the arrow shows a fiber partly enclosed in the reddish paste-like compound, scale bar = 1 mm; b. the arrows show fibers partly enclosed in the compound, scale bar = 1 mm; c. close-up of the same residue, scale bar = 1 mm; d. close-up of flattened spots of adhesive concretion around the neck and sinew fibers embedded. The arrows show the horizontal directionality of compression marks on the residue, scale bar = 1 mm; e. the arrow shows another fiber enclosed in and partly covered by the compound, scale bar = 1 mm; f. polarized high magnification image showing proliferation of fungal spores in the reddish concretion. They are disposed in linear aggregation (so-called string of pearls), scale bar = 0.5 mm (photos by Emanuela Cristiani).

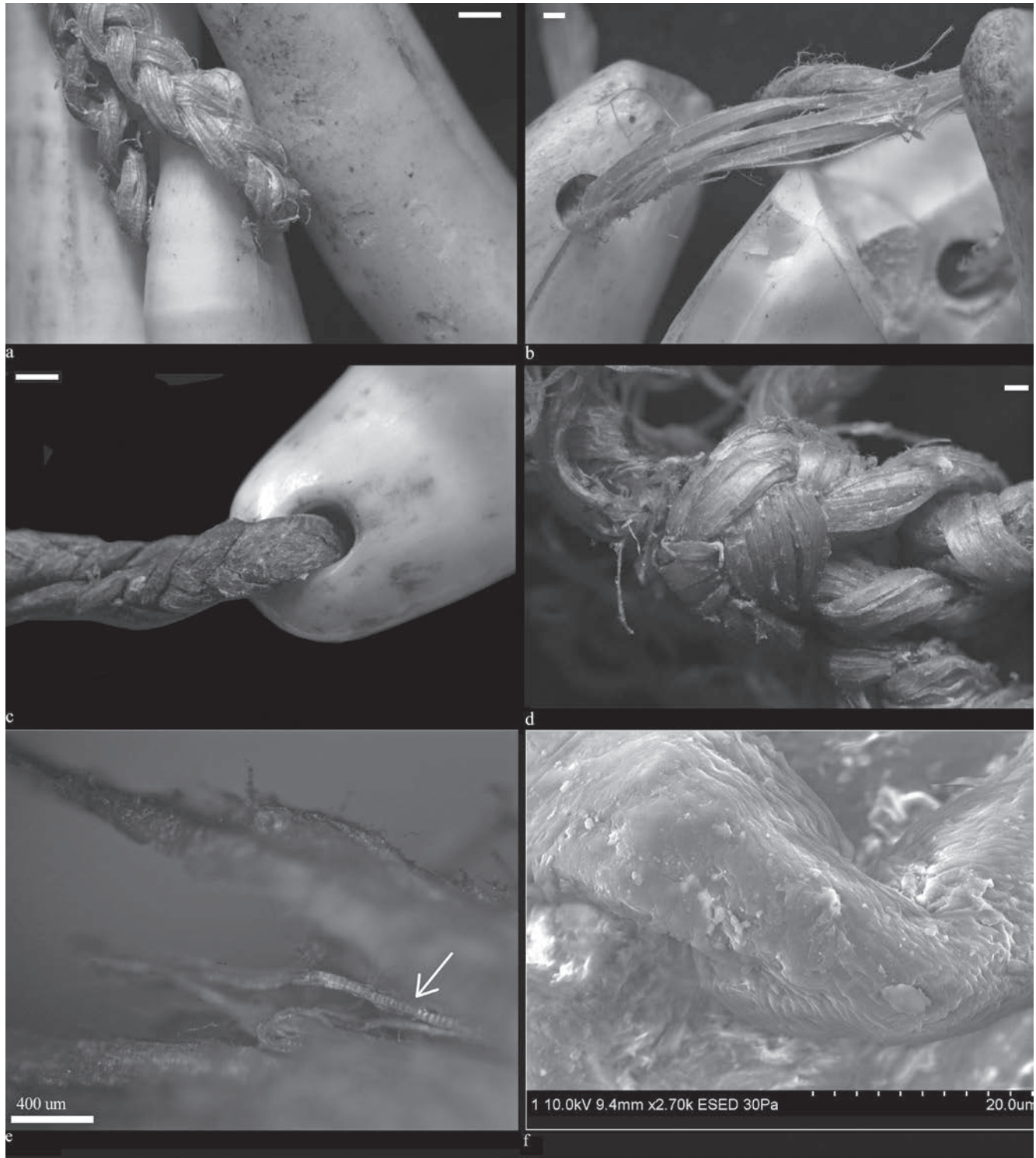


Figure 4.10 Close-up of ethnographic and experimental sinew fibers used in systems of ornamentation: a. interwoven thread made of elk sinew filaments on an Eskimo bracelet (no. Inv. Z.29a), scale bar = 5 mm; b. close-up of sinew fibers from the previous bracelet (no. Inv. Z.29a) with rectangular section and numerous smaller fibrils sticking out of the main filament, scale bar = 1 mm; c. thread of an Eskimo bracelet (no. Inv. Z.29b) made by interweaving sinew fibers, scale bar = 1 mm; d. close-up of a thread made of extremely elastic sinew fibers from the Eskimo bracelet on figure a. and b. (no. Inv. Z.29a); note the amount of small fibrils sticking out from the main sinew fiber, scale bar = 5 mm; e. The arrow shows the transversal wavy/striated appearance of experimental sinew fibers; f. SEM photo of a sinew fiber showing wavy and bundle-like structure as well as presence of smaller fibrils (photos by Emanuela Cristiani).

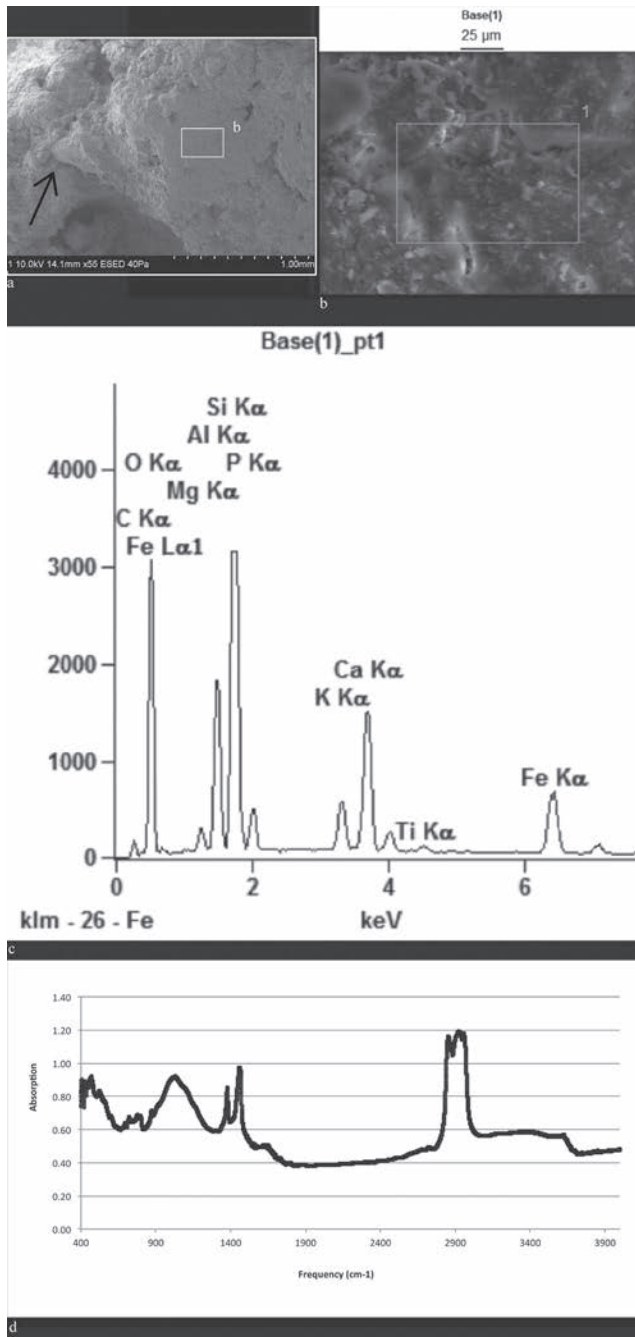


Figure 4.11 Archaeometric analyses of the reddish concretions on pharyngeal teeth from Burial 42a, Vlasac: a. SEM close up on a sample of reddish concretion analysed by EDXS and FT-IR. The arrow shows a thread of sinew embedded in the concretion; b. SEM detail of the analysed concretion (1); c. EDXS spectrum of a sample of concretion located on the neck of one archaeological tooth; d. FT-IR spectrum of the same sample (illustration by D. Borić and E. Cristiani).

the same ornamental territory despite the overlap with cyprinid teeth.

Secondly, technological analysis carried out on cyprinid teeth beads from Vlasac and Hohlenstein-Stadel point out profound differences in the techniques of production and

use of pharyngeal teeth adornments in the two regions of the Danube. In particular, all teeth from Hohlenstein-Stadel were laterally drilled (with a drilling movement in creating a perforation) while, at Vlasac, only a portion of cyprinid teeth were grooved transversally along the neck in order to create a hole whereas a great quantity of teeth were used without modifications but were likely fastened to cloths with various forms of strings and adhesives, which might have included natural glues mixed with red ochre. The use of a cutting action – instead of a rotating movement or pressure/indirect percussion – for creating a hole constitutes a very peculiar technological gesture characterizing the Mesolithic ornamental tradition at Vlasac. Yet, similarities in the use of cyprinid teeth between the Lower and Upper course of the Danube are identified in the application of reddish organic adhesive all around the neck of the teeth (Cristiani et al. 2014b; Rigaud et al. 2014). Ultimately, the comparison between Vlasac and Hohlenstein-Stadel suggests that the combination of sinew threads and adhesive compound might have represented the main technique for ornament suspension among forager communities of both regions along the Danube during the Late Mesolithic.

The picture of the distribution of cyprinid teeth ornaments is further complicated by the existence of two other distant regions where cyprinid teeth ornaments have also been found. First, at the cave site of Zamil-Koba I in the Crimean Peninsula, two modified cyprinid teeth ornaments were associated with a skull burial found in a pit (62 cm in diameter and 30 cm deep) together with other human or animal postcranial bones, charcoal and flint artifacts, indicating a Mesolithic context (Kraynov 1938:14) (Fig. 4.16b). Unfortunately, this context has not been dated directly so we cannot be certain of the contemporaneity of this and other Mesolithic contexts where such ornaments appear (cf. Biagi and Kioseki 2010). The published drawing of one of the ornamental cyprinid teeth shows the shape of a cyprinid pharyngeal tooth and a clearly visible cut on the root of the tooth (Kraynov 1938:23, T. V, 4–5), with the modification made in the same way as on the modified specimens found in the Danube Gorges, suggesting a shared technological gesture if not direct contact between the two regions. This site is more than 900 km away from the Danube Gorges region as the crow flies and still farther away from the Upper Danube region. One could possibly envisage contacts along the Lower Danube and farther along the northeastern coast of the Black Sea (Fig. 4.15).

The second example comes from a recent project by the two of us in the mountainous region of Montenegro at the site of Vrbicka Cave where only one modified carp tooth ornamental bead was found (Fig. 4.15). The modification made on the root of the tooth is identical to the ones made in the Danube Gorges area and may again hint at direct contact between the two regions, which are some 400 km apart. The bead was found in the Late Mesolithic layer of the cave, currently dated to the beginning of the seventh

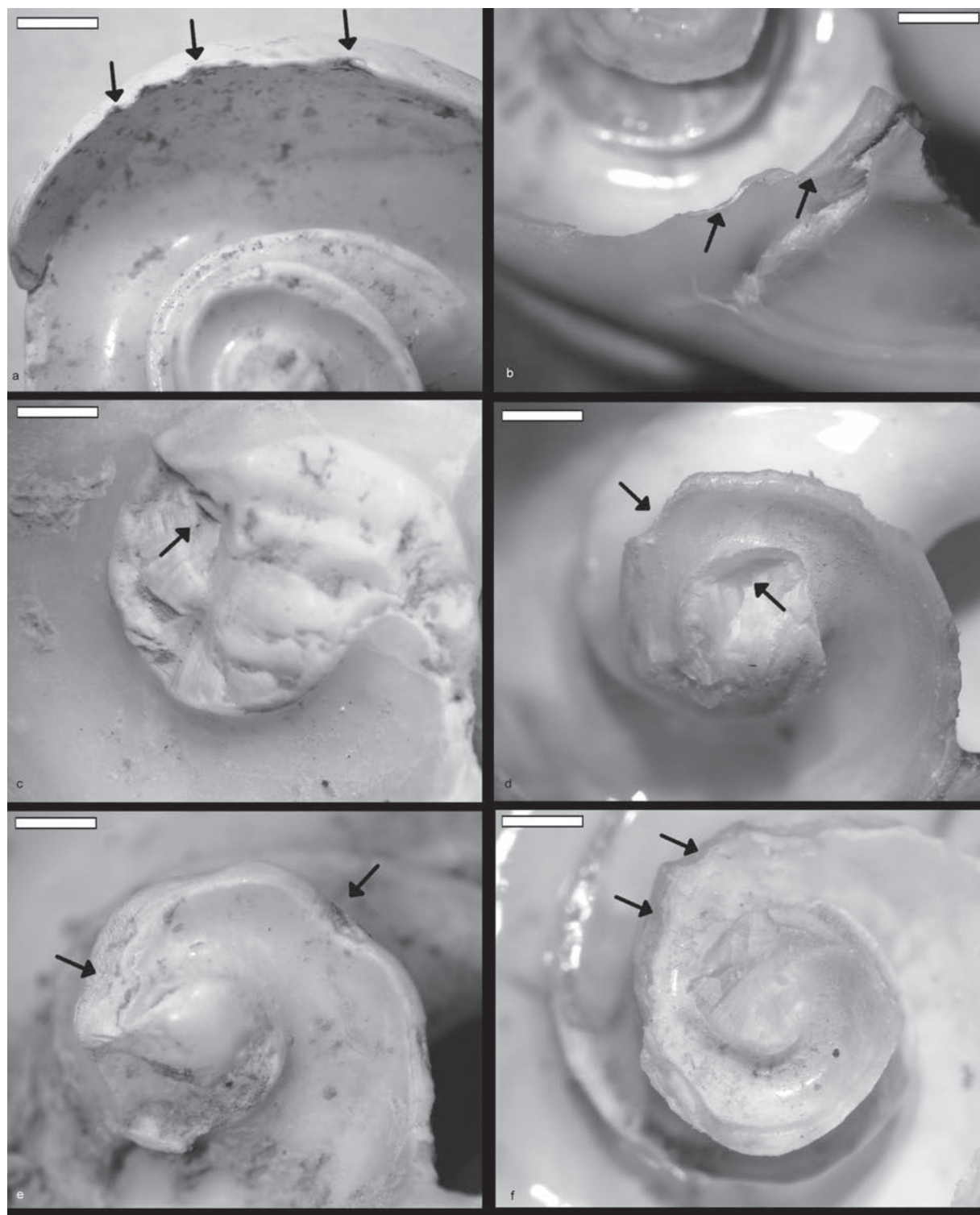


Figure 4.12 Technological traces of pressure technique on Cyclope neritea beads from H297 and experimental comparison: a. close-up of the irregular profiles of walls on an archaeological *C. neritea* bead characterized by a notched outline, scale bar = 1 mm; b. profile of the whorl edges of a modern *C. neritea* shell modified by pressure toward the inside (the black arrows show the points where the resting percussion was applied), scale bar = 1 mm; c. aspect of the apex of an archaeological *C. neritea* bead (the black arrow shows the traces of the apex removal operation), scale bar = 1 mm; d. close-up of micro-chipping produced on a modern shell after the removal of the apex through pressure applied toward the outside of the shell, scale bar = 1 mm; e. negatives of technological removal of the apex of the *C. neritea*, scale bar = 1 mm; f. micro-chipping produced on an experimental *C. neritea* shell for removing the apex through pressure applied toward the outside of the shell, scale bar = 1 mm (photos by Emanuela Cristiani).

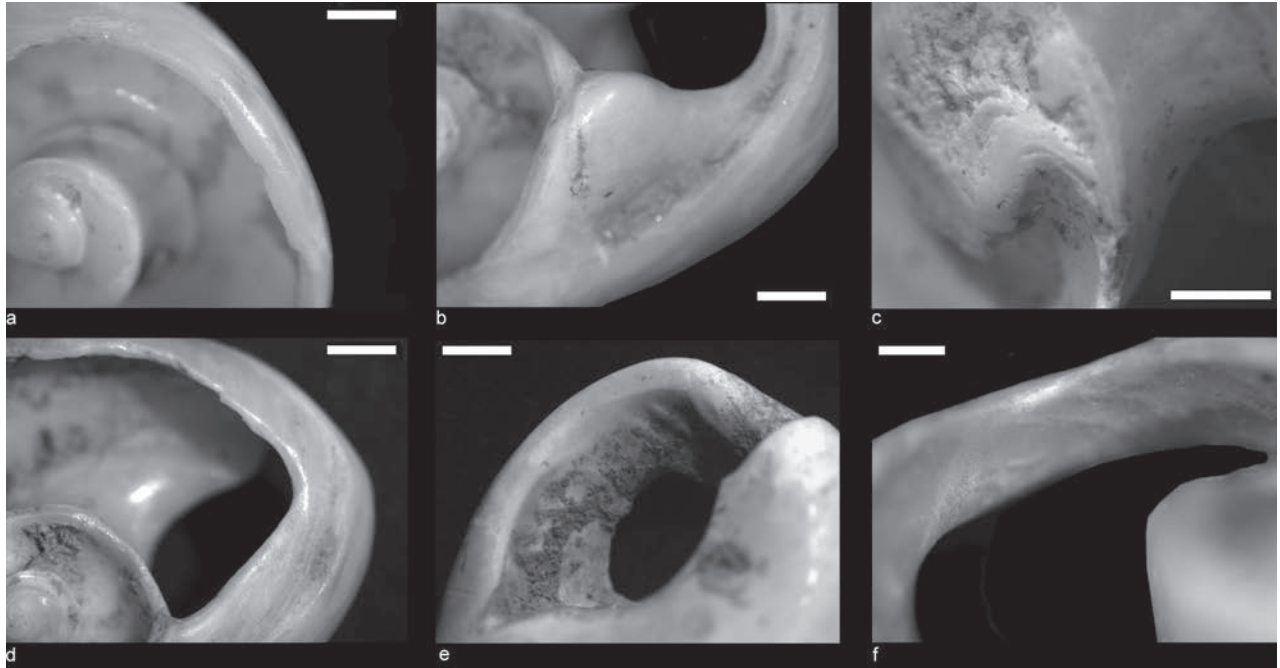


Figure 4.13 Use-wear traces distribution pattern on Cyclope neritea beads from Burials H2 and H297: a. rounding on the whorl edge on a *C. neritea* bead from H297, scale bar = 1 mm; b. close-up of the prominent part of the shell close to the lip showing developed rounding on a *C. neritea* bead from H297, scale bar = 1 mm; c. flat facet observed on the apex of a *C. neritea* bead from Burial H2, scale bar = 1 mm; d. rounding located on the lip on a *C. neritea* bead from H297, scale bar = 1 mm; e. faceting developed on the inside surface of the lip of a *C. neritea* bead from H21, scale bar = 1 mm; f. rounding developed on the inside surface of the lip of a *C. neritea* bead from H297, scale bar = 1 mm (photos by Emanuela Cristiani).

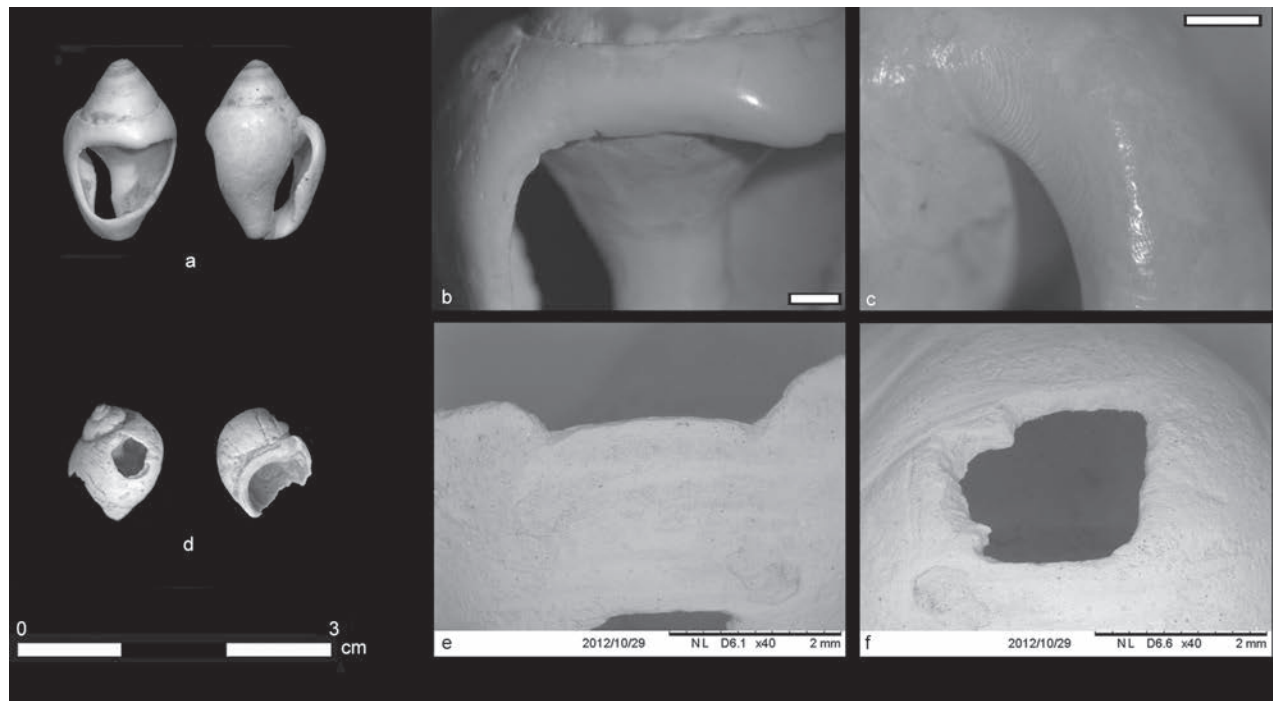


Figure 4.14 a. *Columbella rustica* shell bead from US308; b. very developed rounding and change of color on the left upper edge of the perforation of the previous *C. rustica*, scale bar = 1 mm; c. close-up of the faceting of the upper part of the lip of the shell of the previous *C. rustica*, scale bar = 1 mm; d. *Lithoglyphus naticoides* shell bead from US47; e. SEM image of the deformation of the edge of the shell due to prolonged suspension of the previous *Lithoglyphus naticoides*; f. SEM close-up on a perforation of the previous *Lithoglyphus naticoides* (photos by Emanuela Cristiani).

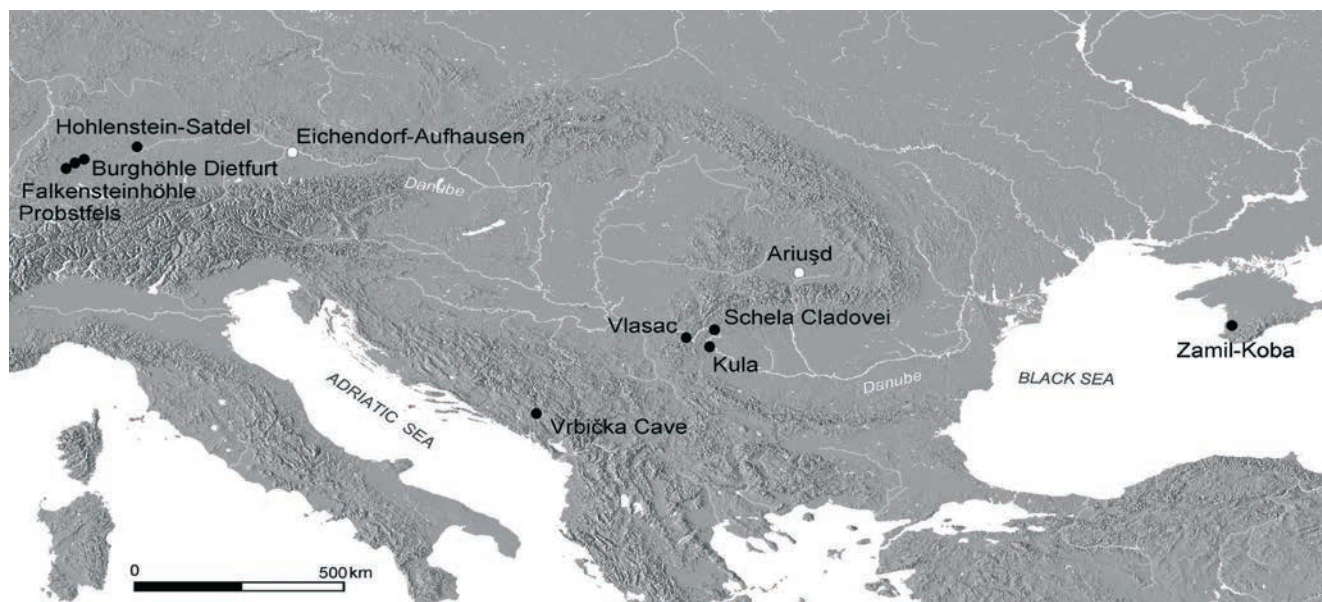


Figure 4.15 Map showing the appearance of carp teeth ornaments in the contemporaneous Late Mesolithic contexts, in the LBK context of the Eichendorf-Aufhausen burial and at the Late Neolithic site of Ariuşd-Cucuteni (illustration by Emanuela Cristiani, redrawn from Cristiani et al. 2014:fig. 15).

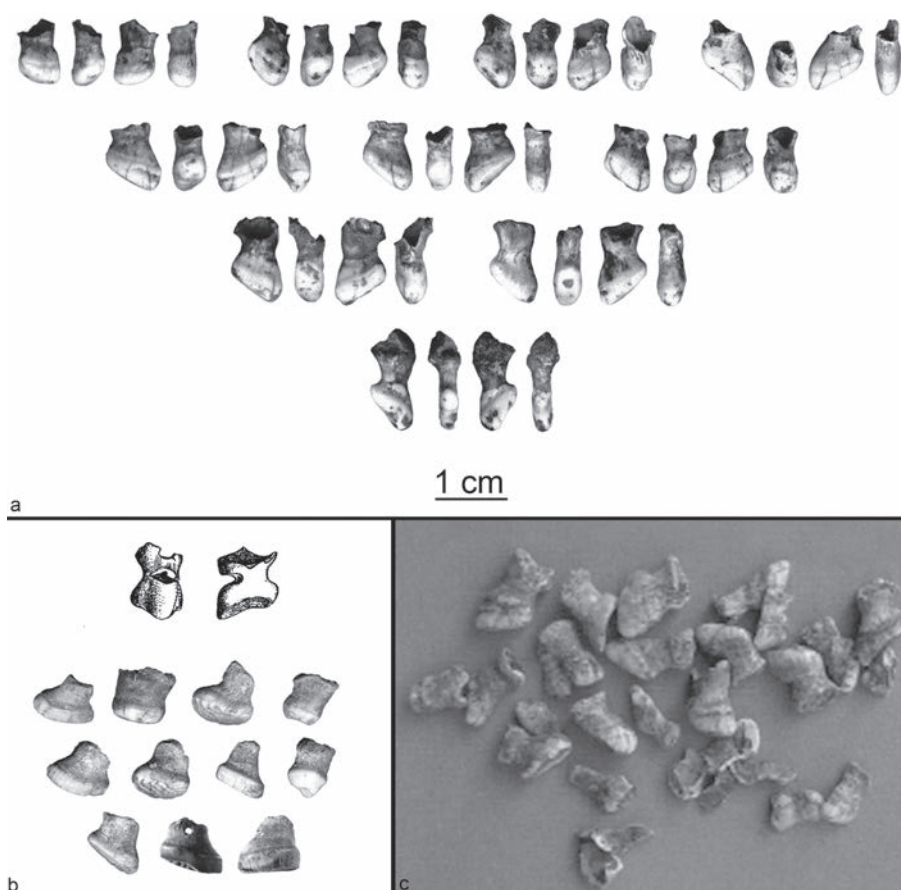


Figure 4.16 Carp teeth ornaments found at: a. the Late Mesolithic context of Hohlenstein-Stadel in Bavaria (adapted after Rigaud 2011); b. the Mesolithic context of Zamil-Koba I in the Crimean Peninsula (Kraynov 1938:14); c. the LBK context of the Eichendorf-Aufhausen burial (adapted after L. Kreiner and Ch. Pscheidl); d. the Late Neolithic site of Ariuşd-Cucuteni in the Carpathian Mountains (adapted after Sztancs and Beldiman 2011).

millennium cal BC (Cristiani 2014), thus being broadly contemporaneous with the contexts where ornamental cyprinid teeth beads were found in the Danube Gorges.

Moreover, in the Upper Danube region, some 20 *Rutilus meidingeri* pharyngeal teeth were also found associated with the area of the ribs and the back (without a more precise position) of a left flexed east-west oriented south-facing Neolithic LBK child burial from the site of Eichendorf-Aufhausen in Lower Bavaria (Kreiner and Pscheidl 2005) (Fig. 4.15). *Rutilus* teeth were not perforated and it is most likely that these were used as ornaments, attached to some sort of clothing (perhaps a cloak?) that the deceased wore at the time of interment (Fig. 4.16c). The context is dated to around 5300–5200 cal BC (communal archaeology web site for Landreis Dingolfing-Landau, B. Gehlen, pers. comm., May 2014). This is the only currently known Neolithic burial with such an association. It would seem unlikely that this instance represents a coincidental use of the same type of teeth ornaments as the much earlier examples from Mesolithic contexts in the general Upper Danube region more than millennium earlier. Yet, it is puzzling how best to explain the transmission of the tradition of using this specific type of ornament coming from a Mesolithic cultural milieu in a clearly Early Neolithic context, characterized by a typically Neolithic, i.e. flexed body posture of the deceased.

Finally, in Southeastern Europe, at the Late Neolithic (ca. 5000–4500 cal BC) site of Ariuşd-Cucuteni, pharyngeal carp teeth used as ornaments with a pierced modification made on the lateral side of the root on one of the specimens were found in settlement deposits (Sztancs and Beldiman 2011:167, tab. 16) (Figs 4.15 and 4.16d). In addition to cyprinid pharyngeal teeth, perforated red deer canines were also found here. Interestingly, this unique resurgence of cyprinid ornament is confined to the area of the Carpathian Mountains. Previously, it has been noted that in certain areas of Southeast Europe, such as parts of the Carpathian Mountains, Dobrudza and Muntenia, the start of the Late Neolithic at the end of the sixth millennium cal BC is marked by the resurgence of particular cultural features that can be associated with the earlier repertoire of Mesolithic practices, such as extended supine burials, use of wild animal skulls in burials and red deer canines (Borić 2013; Lichter 2001).

What processes then are responsible for similarities as well as differences in the ornamental traditions of the two broadly contemporaneous regions connected along the River Danube but significantly apart from each other for any form of regular interaction between these Late Mesolithic communities? Furthermore, what mechanisms should we envisage with regard to the co-occurrence of carp teeth beads with the same type of modification as in the example of those found in the Late Mesolithic contexts in the Danube Gorges, Crimea and Montenegro? Finally, what does the survival of this type of ornamental tradition in the Upper Danube region and the Carpathian Mountains

into the late sixth millennium cal BC mean for the long-term transmission (resurgence?) of particular cultural traits and their associated meanings? We find it unlikely that independent inventions can be suggested in the selection and use of cyprinid teeth in these regions due to the fact that the same particular species of the cyprinid family may have been targeted and that the fish body elements (pharyngeal teeth) chosen to be modified into ornamental beads are highly specific and hardly obvious for this type of idea/decision to be arrived at independently by unrelated peoples. The evidence of such similarities may only speak of shared motivations and meanings that were behind such practices especially considering ornaments as symbolically-charged elements of material culture. The alternative then would be to suggest that this particular shared ornamental trait relates to cultural and symbolic similarities shared between these different regions due to common history and origins or maintenance of contact. Only communities with a shared cultural repertoire of myths, stories, values, knowledge and understanding of the world, in short, a shared ontological grounding, could be expected to use such a highly specific type of ornament during the same period, possibly to express similar concerns. In the case of the Lower and Upper Danube regions, the obvious geographic affordance that connects the two regions is the River Danube. Some sort of exchanges between these distant communities, as well as those found in Crimea and Montenegro are very likely.

For the moment, it remains in the domain of speculation whether this type of ornamental tradition originated in one or the other region first, as we cannot suggest at present any chronological priority for this particular phenomenon found in different regions in the first half of the seventh millennium BC. On the other hand, differences in the technological modifications imply that while the Lower and Upper Danube regions shared the same raw material used for making ornamental beads, at the same time, differences in the technology of producing a perforation on the root of a cyprinid tooth must have stemmed from different know-hows and a specific *chaîne opératoire*. This suggests that while the choice of species and body element used for making beads were important and might have been discursively marked, the way these ornaments were modified remains embedded in non-discursive practices and gestures of the everyday that were specific to each region. Following this logic, specimens from Montenegro and Crimea, which share the same style of modification as those in the Danube Gorges, were possibly exchanged over very long distances.

We have previously noted the curious absence of red deer canines in the Danube Gorges in the course of the Late Mesolithic (Cristiani and Borić 2012:3463). This seems a strange phenomenon when contrasted with the abundance and popularity in the use of red deer canines as ornaments in the course of the Upper Paleolithic and Mesolithic of Europe and beyond (e.g. Newell et al. 1990; Vanhaeren and

d'Errico 2005; 2006). We suggested that the lack of this particular type of ornament in the Danube Gorges region might have been closely related to the “rise” in the use of cyprinid teeth ornamental beads. In other words, it seems that at a certain point in the Late Mesolithic, around the start of the seventh millennium BC, or perhaps even earlier, the same range of meanings held in relation to red deer teeth ornaments by various Mesolithic communities might have been “delegated” to cyprinid teeth in the Danube Gorges region, and perhaps beyond. That a river animal's body element was chosen as a source of material for ornaments for communities living along the big river should not be surprising. There is evidence from the Danube Gorges that various species of fish might have had totemic significance among these communities (cf. Borić 2005; Radovanović 1997). But it is also that to some extent cyprinid teeth can be seen to resemble red deer canines in shape, the appearance when sewed on clothing, and regarding their position in the animal's body, being “hidden” within the body, i.e. invisible before opening the body of each respective animal. Most importantly, carp pharyngeal teeth might have been selected to play the same role as red deer canines.

This feature would strongly correspond to a way of conceiving rules of transformation by inversion, symmetry, and substitution as advocated by Lévi-Strauss (1987, 1995) in his structural analysis of myths, as hinted at in the introduction of this paper. As previously emphasized, we believe that the mythical thought and the way elements of similar myths were found among very distant groups could be seen as homologous to the way ornaments were used and distributed. Further elaboration of this point is out of the scope of this paper and we will explore this issue elsewhere. However, it suffices to say that we believe that this may be a potent way of explaining the enigmatic distribution of the same type of ornament, i.e. cyprinid teeth beads, in several geographically very distant regions, either along the River Danube or farther afield.

Finally, we speculate that using pharyngeal teeth of the *Rutilus* species, also known by its common German name as *perlfisch*, given the appearance of pearl-like tubercles on the head and back (see above), for ornamenting the attire of Late Mesolithic inhabitants of the region might have been imbued with symbolic and mimetic potential of resembling/imitating this species of fish and, eventually, literally investing/implementing its body elements as ornamental beads. It has previously been argued that sculpted sandstone boulders from Lepenski Vir and mortuary practices in the Mesolithic Danube Gorges are suggestive of beliefs in body metamorphosis of humans into fish-like hybrid creatures in death, specifically in relation to the sturgeon family (cf. Borić 2005; Radovanović 1997). One possibility could be that wrapping corpses in clothing or shrouds that had *Rutilus* pharyngeal teeth attached to them, might have been intended to ensure the process of the prescribed (and safe) body

metamorphosis into this particular species of fish. Hence, the presented evidence of *Rutilus* bead ornamentation may indicate that this species along with sturgeon might have been linked in a number of important ways to the notion of shape-shifting, and corporeal transformation. All this underlines profound links and relations between humans and certain species of animals in this cultural context, as it is to be expected from hunter-fisher-gatherers characterized by either animic or totemic modes of relations (*sensu* Descola 2013; Ingold 2000).

Our analysis of cyprinid teeth and *C. neritea* ornaments from various burials from Vlasac also provides very important data for reconstructing the traditional way ornaments were arranged on the body of the wearer, i.e. on clothing, among Late Mesolithic people. These ornaments were used as appliqués, likely embroidered onto custom fitted-garments/cloaks. Traces of wear on both cyprinid teeth and *C. neritea* ornaments found in burials H2, H297, and 42a suggest that these were used for a very long time, which allows one to hypothesize that such ornaments were not made for a specific mortuary event alone. Hence, such pieces of ornamented clothing might have been both every day and/or ceremonial. The fact that heavily worn ornaments were associated with one-year-old children in Burials H297 and 42a indicates that part of these ornamented garments were inherited (in the same family?) from those who wore it before her/him. Alternatively, ornaments might have been recycled from older dresses. The association of rich repertoires of heavily worn ornaments with children leaves us wondering whether at Vlasac social status was hereditary, transmitted to the children and marked by a large number of ornaments or, in other words, whether these ornaments associated with various burials of children might constitute direct evidence for the presence of high status social groups and hereditary ranking system (cf. Vanhaeren and d'Errico 2005 for a similar interpretation of an Upper Paleolithic context). However, we believe that the general tendency at Vlasac for more ornaments associated with children than adults might better be a reflection of symbolic/protective qualities of ornaments, as repeatedly documented among ethnographic societies (e.g. Miller 2009).

Our analysis of ornaments from Vlasac showed that perforated cyprinid teeth were sewn onto clothing by utilizing the perforation, whereas the unmodified specimens were laced by retaining them around the natural neck of the carp tooth (Figs 4.17, 4.18). Further, contextual information reveals that *C. neritea* beads were sewn separately one from the other and attached to a cloth by the lip with the white base facing outwards on the back of the body. Also, the technological removal of the convex surface (i.e. the colored body whorls) of *C. neritea* characterizes a very peculiar local tradition, which reveals the necessity of creating a white/beige bead with a flat profile, probably more functional and meaningful for the embroiderer.



Figure 4.17 A reconstruction of cloak-type embroidered garment worn by adult females and children at Late Mesolithic Vlasac on the basis of ornaments' distributions in Burials H2 and H297 (drawing by Mauro Cutrona).

Additionally, the presence of *C. neritea* shells at Vlasac, although uniquely transformed, also sheds light on specific routes and networks that were active during the Mesolithic and which connected the central Balkans with distant areas such as the Black Sea, Adriatic Sea and Aegean coastal regions, where also *C. rustica* may have been collected. While these marine gastropods are typical of rocky and sandy seashores of the northern Adriatic region, *C. neritea* can also be found at the confluence of the Danube and the Black Sea. The acquisition of both *C. neritea* and *C. rustica* might have involved very long distance exchange routes as the two regions, the Adriatic and the Black Sea, are located ca. 400 km away from the Danube Gorges as the crow flies.

The targeted selection of *C. rustica* during the Mesolithic in the Balkans is equally worth a detailed consideration. This gastropod shell was repeatedly selected as a material strategy for the creation, expression and maintenance of local Mesolithic foragers' identity and social networks during the Mesolithic across the Adriatic region. In particular *C. rustica* was ubiquitous in the eastern Alpine area, at sites such as Riparo Soman, Riparo Romagnano-Loc III, Riparo Gaban, Riparo Pradestel, Vatte di Zambana in the Adige Valley

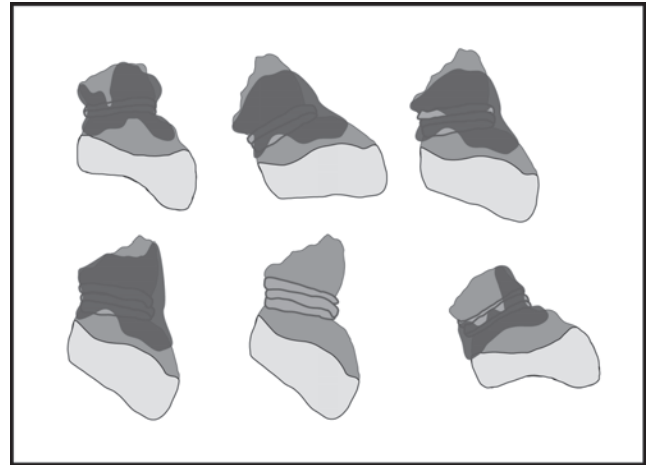


Figure 4.18 Reconstruction of the suspension technique for cyprinid teeth on the basis of Burial 42a, Vlasac (drawing by Emanuela Cristiani).

and Edera, Ciclami and Azzurra caves in the Trieste Karst (Boschian and Pitti 1984). It is also found at high altitude sites, such as Plan de Freà and Mondeval de Sora, across the eastern Adriatic and in its hinterlands at Pupičina Cave in Istria, Zala Cave in central Croatia, Crvena Stijena and Vrbička Cave in Montenegro (Basler 1975; Komšo and Vukosavljević 2011; unpublished data). The exceptional quantity of *C. rustica* documented in the Adriatic region extends to the central Balkans (Borić et al. 2014) as well the Pyrenees region and the Mediterranean coast of Spain (Álvarez-Fernández 2006) during the Early Holocene. In this context, it is particularly significant that Burial 49, one of only two nonlocal individuals on the basis of strontium isotope analysis (Borić and Price 2013), is the only Late Mesolithic individual at Vlasac that was associated with 11 *C. rustica* beads, and suggest that this possible female originated in areas outside the Danube Gorges, perhaps even from one of the mentioned coastal regions. Yet, the presence of cyprinid teeth beads in the same burial as likely elements of the local ornamental tradition clearly demonstrates the complexity in the relational use of materialities to construct a personhood in the Mesolithic Danube Gorges. The same might have been the case elsewhere across the world of contemporaneous forager communities.

Conclusions

We discussed technological choices associated with ornaments' production and use at the Late Mesolithic (ca. 7400–6200 cal BC) site of Vlasac in the Danube Gorges, which in this regional context yielded the most numerous and well-preserved repertoire of ornamental beads. More than three thousand ornaments were found both in burials and dwelling contexts excavated at this site. These ornaments underwent technological, use-wear, and residue analyses, the results of which are key for our understanding of the

way social identities and personhood were constructed in this region of the central Balkans.

The region exhibits a number of ornamental choices that are also found in the rest of the Balkans and the Apennine Peninsulas. Yet, cyprinid pharyngeal teeth ornaments in particular make this regional ornamental tradition comparable to the similar use of cyprinid pharyngeal teeth of the same genus of carp family (*Rutilus*) among contemporaneous Mesolithic sites in the Upper Danube River, mountainous hinterland of Montenegro and the Crimean Peninsula. In the case of those regions along the Danube, it might have been an opportune move to use a resource that was likely abundantly available in the Danube River and some connections to the symbolic role of particular species of fish and the creation of totemic links can also be suggested. Yet, importantly, it seems that cyprinid pharyngeal teeth in the Danube Gorges area in particular opportunistically fulfilled the role that was in earlier times as well as among some contemporaneous Mesolithic communities held by ornaments made of red deer canines. In the symbolic universe of ornament use that is akin to the way mythical narrative structures work, identical symbolic function might have been given to a completely different species as a structural effect of inversion and symmetry.

We should also add that the use of *C. neritea* marine gastropod shells in this region in the course of the Mesolithic remains temporally and technologically (by making a specific modification) a very unique occurrence. While *C. neritea* beads are found elsewhere in the preceding Paleolithic and Epipaleolithic periods their popularity declined in various regions of Mediterranean Europe in the course of the Mesolithic. This makes the reappearance of *C. neritea* ornaments in the Danube Gorges in the Late Mesolithic burials that much more surprising. The only exception to this uniqueness in the use of *C. neritea* beads in the course of the Late Mesolithic is the repertoire of ornaments associated with Mesolithic levels at Franchthi Cave in Greece (cf. Perlès and Vanhaeren 2010). Yet, at Franchthi such ornamental raw material might have been relatively abundant and common occurrence, also judging by a large number of these gastropod shells in the site's deposits (Shackleton 1987) and in the close proximity of the cave, whereas their transport to the Danube Gorges must have required long voyages (over 400 km) or well-established down-the-line exchange systems in place.

These two elements of the ornamental system – local cyprinid pharyngeal teeth and “exotic” *C. neritea* marine gastropods – more than other types of ornaments found in the Late Mesolithic of the Danube Gorges may suggest that the sense of personhood and belonging might have been constructed in this region during this period along two different but related axes: by reference to origin myths, specific to this and, so far, several other regions hundreds of kilometers apart from each other, as well as by evoking

material that originated in distant coastal regions that might have remained outside the direct experience and perception of most community members throughout their lifetimes. This dialectical play of the local and exotic may reflect modes of relations in which these different contemporaneous communities related to each other's repertoire of symbolic and mythical by sharing particular worldviews. It is ornaments, their transferability and visual allure, along with meanings behind their appropriate, prescribed and/or desirable usage, which particularly effectively connected and defined people through webs of relational assemblages.

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Ornamental Shell Beads as Markers of Exchange in the Pre-Pottery Neolithic B of the Southern Levant

Ashton J. Spatz

Abstract: *Ornamental shell beads are useful in analyzing exchange in prehistory as they can be sourced to their area of origin through a species level identification. The marine mollusk shells recovered from Pre-Pottery Neolithic B (PPNB) sites in the southern Levant provide clear evidence for long-distance exchange because these shells are found at great distances from their marine sources – the Red Sea and the Mediterranean Sea. Although this has been widely discussed in the literature, a quantifiable study of the mechanisms of exchange has not yet been conducted. In order to better understand these exchange networks, mollusk assemblages from several PPNB sites throughout the southern Levant are examined to evaluate if they conform to a down-the-line exchange model following that proposed by Renfrew for obsidian exchange in the Mediterranean. These assemblages are also analyzed to determine whether the shells were traded as raw material (i.e. complete shells) or as finished products (i.e. beads). While shells from both marine sources do seem to conform to the proposed down-the-line exchange model, only those from the Mediterranean Sea appear to have been exchanged primarily as finished products.*

Introduction

This paper will focus on marine mollusk shells from the Pre-Pottery Neolithic B (PPNB) southern Levant that elucidate exchange networks in the region. The geographic focus of this research is the southern Levant (see Fig. 5.1), a complex environment that includes two climatic zones: the Mediterranean zone (Miller Rosen 2007:32) and the arid zone (Kuijt and Goring-Morris 2002). Temporally, this research is set during the Pre-Pottery Neolithic B (PPNB) period, which falls between approximately 10,500 cal BP and 8,700 cal BP, and is further subdivided into the Early PPNB (10,500–10,100 cal BP), Middle PPNB (10,100–9,250 cal BP), and Late PPNB (9,250–8,700 cal BP) (Kuijt and Goring-Morris 2002:366). Specifically, this study is focused on the Middle PPNB period. The PPNB period in the southern Levant is characterized by several major developments, including changes in settlement patterns, architectural styles, artifact types, technological innovations in material culture, mortuary practices and increased subsistence means (Banning 1998; Rollefson

2003; Simmons 2007). Architectural styles are varied during the PPNB based primarily on the climatic zone of the settlement. Typically in the Mediterranean zone, rectilinear shapes are common, while the arid zone settlements are generally composed of round or oval structures with semi-subterranean foundations (Kuijt and Goring-Morris 2002:389–392).

Beads and personal ornaments were made from a variety of different materials. Beads have been recovered from excavations from the PPNB southern Levant made from stone, bone and shell (Bar-Yosef Mayer 2005, 2013; Garfinkel 1987; Garfinkel and Kolska Horwitz 1988; Marshall 1982; Rollefson and Simmons 1985, 1986; Spatz et al. 2014; Spatz and Baluh 2014; Wright and Garrod 2003). This research focuses on beads and personal ornaments made from marine mollusk shell. There are two varied marine sources for the mollusks from this study – the Red Sea that is Indo-Pacific in origin (Kolars 1993:189) and the Mediterranean Sea, which is Atlantic in origin (Yasso 1993:381). Through a species level analysis, the shells can

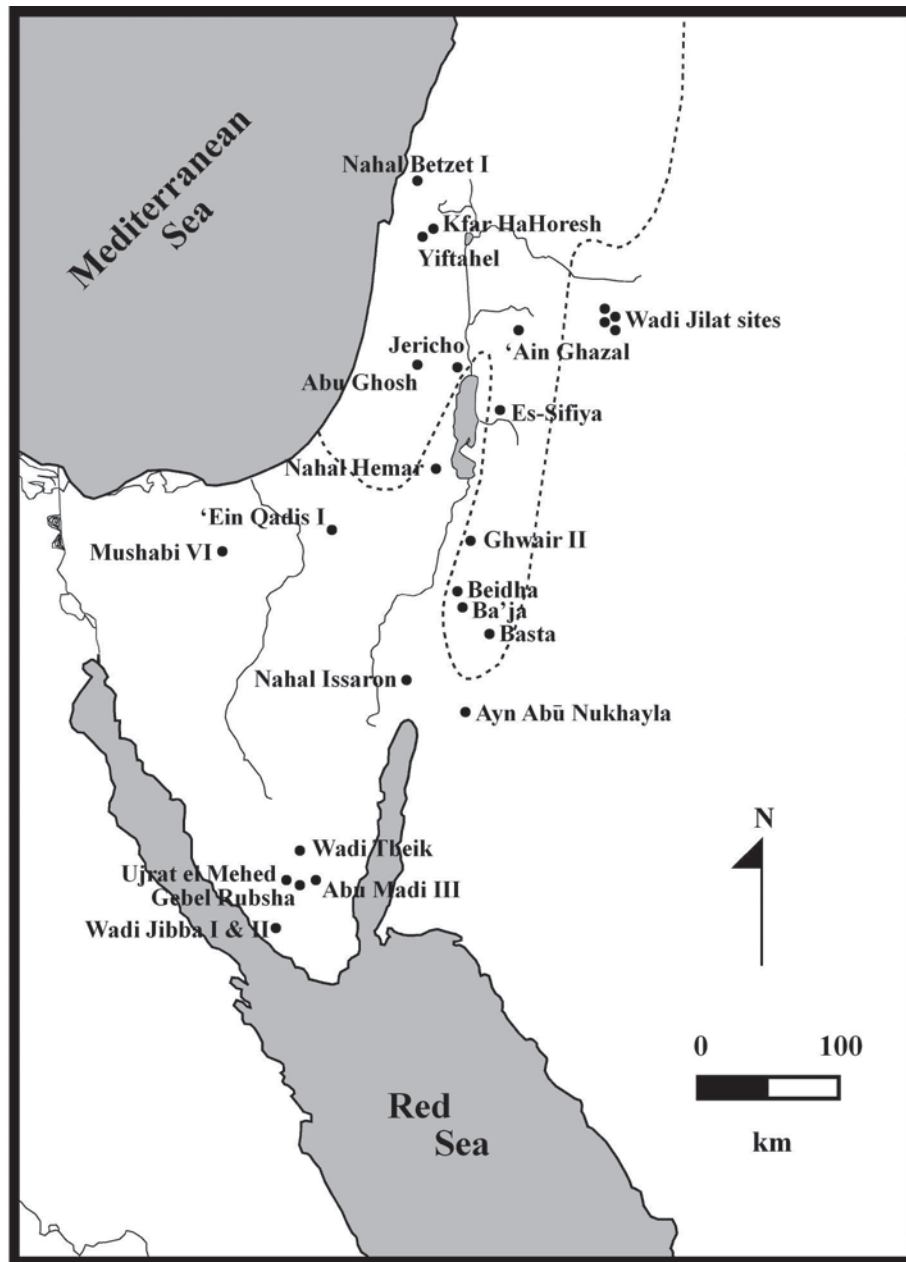


Figure 5.1 Map of PPNB Sites in the southern Levant and an approximate boundary (dashed line) between the Mediterranean zone and the arid zone (from Spatz 2008:16, modified after Bar-Yosef Mayer 1999; Kadowaki 2002; Kuijt and Goring-Morris 2002).

be sourced to either the Red Sea or the Mediterranean Sea as the mollusk species that inhabit these two bodies of water are distinct in nature (Bar-Yosef Mayer 1999). As a result, this particular class of material culture lends itself well to an analysis of exchange networks and trade routes in antiquity.

Throughout the PPNB southern Levant numerous types of artifacts provide evidence that long-distance exchange occurred in this geographic region (Bar-Yosef Mayer 1997a, 1999; Khalaily and Marder 2003; Mienis 1988; Reese 1991). Specifically, marine mollusk shells from both the Red Sea and Mediterranean Sea have been unearthed from PPNB sites that

are at vast distances from both these bodies of water. To date, there has been a great deal of speculation surrounding the mechanisms of these exchange networks. Bar-Yosef Mayer (1997a, 1999) hypothesized that the Red Sea shells were exchanged from the hunter-gatherers of the arid zone to the more sedentary people inhabiting the Mediterranean zone for cereals as a component of the economy. Bar-Yosef Mayer (1999) also hypothesized that the pattern of this trade took the form of down-the-line exchange; following this particular model of exchange, artifacts will be most abundant close to their source and decrease in quantity as the distance from the

source increases (Renfrew et al. 1968). The aim of this paper is to examine whether southern Levantine PPNB marine mollusk shells conform to this down-the-line model of exchange.

Methodology

Renfrew and colleagues (Cann et al. 1969; Renfrew et al. 1968) have studied the distribution and exchange of obsidian throughout the Mediterranean region and have concluded that it was distributed via down-the-line exchange. Obsidian is a material that can be sourced to its place of origin through trace element analysis, making it a valuable type of raw material to examine in terms of exchange. In the down-the-line exchange model, obsidian is most plentiful close to its source and decreases exponentially (on a logarithmic scale) in a linear fashion as the distance of the site increases from the source locale (Renfrew et al. 1968). Obsidian has been examined in terms of the percentage of obsidian tools to other types of raw material utilized to create chipped stone tools, and “it has generally been found that the proportion of obsidian tools to those of other chipped stones is very high in regions close to the natural source, and low further away” (Cann et al. 1969:588).

A number of southern Levantine PPNB sites and their marine mollusk assemblages have been analyzed to see if they do, in fact, adhere to this down-the-line exchange model proposed for obsidian in the Mediterranean. In order to conduct this analysis, 13 PPNB sites were selected: Ayn Abū Nukhayla, Urjat el Mehed, Wadi Tbeik, Gebel Rubsha, Wadi Jibba I, Wadi Jibba II, Abu Madi III, ‘Ein Qadis I and Nahal Hemar from the arid zone, as well as Abu Ghosh, Yiftahel, Kfar HaHoresh and Nahal Betzet I from the Mediterranean zone (see Fig. 5.1). These sites were selected for the study owing to the detailed nature of the information on their mollusk assemblages published at the time of this examination, their temporal focus, as well as their representation of both climatic zones and disparate sized nomadic and sedentary settlements. The aforementioned sites have a specific temporal focus on the Middle PPNB or the early part of the Late PPNB: all sites included in this research were dated to the PPNB period either through radiocarbon dates or stylistic features of the material culture with a particular focus on lithics. The sites included in this analysis are quite varied in nature: they encompass both the arid and Mediterranean zones, they include both large and small sized settlements, and they were occupied seasonally by hunter-gatherer groups as well as year-round by sedentary people – creating a representative sample of the southern Levant during the PPNB period.

The marine mollusk assemblages have been examined based on both the source (either Red Sea or Mediterranean Sea) and the presence of shell-working being conducted on site. Shell objects are analyzed based on how and if they were worked by humans in prehistory. Beads are the most common type of shell ornamentation that has been

recovered from archaeological excavations in general and PPNB southern Levantine contexts specifically. These beads include natural and formed beads: “natural beads are small objects whose original form is still identifiable. Formed beads are those where deliberate shaping has obliterated the original form” (Moholy-Nagy 1989:141). Essentially, natural beads merely have a hole in them, making these objects suitable for stringing that allows them to be used as beads by people (Bar-Yosef Mayer 1999; Francis 1982, 1989; Moholy-Nagy 1989). Both of these bead forms have been recovered from southern Levantine PPNB contexts. It is typically interpreted by researchers that shell-bead manufacturing occurred at a site if raw material (i.e. complete unworked shells), debris (i.e. broken and fragmented pieces of shell), and completed products (i.e. beads) are all recovered (Arnold and Munns 1994; Feinman and Nicholas 1993; Kenoyer 1984).

As previously discussed, Renfrew’s model for obsidian was utilized in order to examine the marine mollusk shells from the aforementioned PPNB sites (Cann et al. 1969; Renfrew et al. 1968). In order to test the hypothesis that marine shells were traded through down-the-line exchange networks in the southern Levant, the distance of each PPNB site from the source locale in question as well as the proportion of the shell assemblage comprised of shells from that source is necessary. As this research examines the plausibility of down-the-line exchange from both the Red and Mediterranean seas, terrestrial and freshwater shells that were present in the shell assemblage will be omitted from this study as it appears that the majority of the terrestrial and freshwater shells were not brought to these PPNB sites for use as ornamentation. Additionally, any shells that could not be sourced because they are unidentifiable at the species level were left out of the analysis as they would have skewed the data (Spatz 2008). The complete dataset on the mollusk shell assemblages is displayed in Table 5.1 in spite of the fact that the freshwater shells, terrestrial shells and shells of unknown origin have been omitted from this analysis.

In addition, the shells are examined in terms of the percent of shells that are worked. When examining the Mediterranean shells from the site of Ayn Abū Nukhayla, which were most likely obtained through some form of long-distance exchange, they were typically worked (Spatz 2008). Following this example and the previously discussed model, as the distance from the source increases and the proportion of shells from that source decreases, it should hold true that the proportion of shells from that source that were worked as beads or other ornaments should also increase.

Results

The Arid Zone Sites

Located in southern Jordan, the site of Ayn Abū Nukhayla is characterized by curvilinear architecture and is believed

by the excavator to represent a series of episodic, long-term, seasonal PPNB encampments; this site is thought to have been occupied during the wetter winter months by people who had an economic strategy that involved a combination of hunting-gathering, herding and farming (Henry et al. 2003). The large marine mollusk assemblage consists primarily of Red Sea shells while only a small portion of the assemblage is made up of Mediterranean Sea shells (Spatz 2008; Spatz et al. 2014) (see Tab. 5.1). Owing to the fact that the Mediterranean Sea is approximately 195 km from the site, these specimens were most likely obtained through long-distance exchange. The high proportions of both worked and unworked shells in conjunction with the entire range of shell-working materials, including raw material, debris and completed products, indicates that shell-working most likely occurred at this site (Spatz 2008:80–81) (see Tab. 5.2).

Ujrat el Mehed, Wadi Tbeik, Gebel Rubsha, Wadi Jibba I and II and Abu Madi III are all southern Sinai sites with marine mollusk assemblages clearly dominated by Red Sea shells. The proximity of these sites to their marine source makes this fact not that surprising. Ujrat el Mehed is most likely a summer occupation site of a hunting society that consists of curvilinear semi-subterranean architectural structures (Bar-Yosef 1982, 1984, 1985; Bar-Yosef Mayer 1999). This site has a marine mollusk assemblage that is one of the largest known shell assemblages recovered from the arid zone of the southern Levant. Shell bead production most likely occurred at this site as the entire range of shell-working material has been recovered by excavators (Bar-Yosef Mayer 1999; Spatz 2008). Wadi Tbeik, Wadi Jibba I, and Wadi Jibba II are all examples of winter camp sites most likely occupied by hunter-gatherers and characterized by curvilinear architecture that is typical of the arid zone (Bar-Yosef 1982, 1984, 1985; Bar-Yosef Mayer 1999;

Tchernov and Bar-Yosef 1982). The mollusk assemblages from these three sites vary in size (Tab. 5.1), and they all demonstrate evidence that shell bead manufacturing occurred on site. Specifically, Wadi Jibba I may have been a workshop for the production of *Conus* sp. shells (Bar-Yosef Mayer 1999). Both Gebel Rubsha and Abu Madi III lack evidence of architecture (Bar-Yosef 1982, 1984, 1985; Bar-Yosef Mayer 1999) as well as shell bead manufacturing (Bar-Yosef Mayer 1997a, 1999; Spatz 2008). No complete shells have been recovered at Gebel Rubsha. After analyzing the assemblage from the “rock shelter” of Abu Madi III, Bar-Yosef Mayer (1999:61) concluded that, “ready-made beads were brought to the site and bead production, if it existed at all, was not an important activity at the site”.

‘Ein Qadis I is located in the northern Sinai region on the western edge of the Negev Highlands. The site is characterized by unique architecture – a sub-rectangular to oval shaped stone structure with a hearth feature – that appears to be intermediate between the usual rectilinear architecture of the Mediterranean zone and the curvilinear honeycomb shaped architecture of the desert areas of the southern Levant (Gopher et al. 1995). While the site’s shell assemblage is quite small, both Red Sea and Mediterranean Sea shells have been recovered. The majority of the assemblage is made up of Red Sea shells while Mediterranean Sea shells account for a much smaller proportion (Mienis 1995). It is quite interesting that Red Sea shells dominate this assemblage as this site is actually located closer to the Mediterranean Sea. This small shell assemblage is also very fragmentary, making it impossible to determine whether or not shell bead manufacturing took place at the site of ‘Ein Qadis I (Mienis 1995; Spatz 2008).

Nahal Hemar Cave is a site located in the southern end of the Judean Desert, interpreted by the excavators as a storage

Table 5.1 PPNB shell assemblages and source (from data compiled in Spatz 2008).

Site	Climatic zone	Total shell count	Marine mollusk species count	Dominant source	Red Sea shells	Mediterranean Sea shells
Ayn Abū Nukhayla	Arid	1,302	68	Red Sea	87.4%	3.4%
Ujrat el Mehed	Arid	3,386	45	Red Sea	88.42%	2.27%
Wadi Tbeik	Arid	1,283	34	Red Sea	96.41%	3.43%
Gebel Rubsha	Arid	139	24	Red Sea	98.56%	1.44%
Wadi Jibba I	Arid	212	27	Red Sea	99.53%	.47%
Wadi Jibba II	Arid	101	24	Red Sea	97.03%	1.98%
Abu Madi III	Arid	196	28	Red Sea	83.16%	3.06%
‘Ein Qadis I	Arid	17	10	Red Sea	70.59%	11.76%
Nahal Hemar	Arid	514	15	Mediterranean Sea	17.9%	81.91%
Abu Ghosh	Mediterranean	432	16	Mediterranean Sea	.69%	66.67%
Yiftahel	Mediterranean	392	16	Mediterranean Sea	.51%	47.7%
Kfar HaHoresh	Mediterranean	154	10	Mediterranean Sea	1.3%	94.16%
Nahal Betzet I	Mediterranean	30	7	Mediterranean Sea	0%	90%

Table 5.2 PPNB shell assemblages and shell bead manufacturing (modified from Spatz 2008:159).

Site	Dominant source	Shell bead manufacturing
Ayn Abū Nukhayla	Red Sea	Shell bead production most likely occurred at the site.
Ujrat el Mehed	Red Sea	Shell bead production most likely occurred at the site.
Wadi Tbeik	Red Sea	Shell bead production most likely occurred at the site.
Gebel Rubsha	Red Sea	Shell bead production probably did not occur at the site. If it did, it was in small quantities.
Wadi Jibba I	Red Sea	Shell bead production most likely occurred at the site. Site was most likely a <i>Conus</i> sp. shell workshop.
Wadi Jibba II	Red Sea	Shell bead production most likely occurred at the site at least in small quantities.
Abu Madi III	Red Sea	Shell bead production probably did not occur at the site. If it did, it was in small quantities.
‘Ein Qadis I	Red Sea	There was no mention of complete shells in the report. Therefore, it could not be examined whether or not shell bead manufacturing occurred at the site.
Nahal Hemar	Mediterranean Sea	Shell bead production most likely occurred at the site, or complete shells were cached at the site for ceremonial purposes.
Abu Ghosh	Mediterranean Sea	Shell bead manufacturing may have been occurring at the site. However, due to the incomplete reporting of worked and complete shells, it is difficult to know.
Yiftahel	Mediterranean Sea	Shell bead production most likely occurred at the site.
Kfar HaHoresh	Mediterranean Sea	There was no mention of complete shells in the report. Therefore, it could not be examined whether or not shell bead manufacturing occurred at the site.
Nahal Betzet I	Mediterranean Sea	Shell bead manufacturing could have been occurring at the site, or raw material could have been stored at the site for exchange due to the low proportion of worked shells.

facility for objects of ritual significance. Consequently, the site is believed to be a locale for ritual activity during the PPNB (Bar-Yosef and Alon 1988). Nahal Hemar Cave is dominated by Mediterranean Sea shells, but Red Sea shells also make up quite a large percentage of the total shell assemblage. As Nahal Hemar Cave is located a long distance from both the Red Sea and the Mediterranean Sea, the occupants of the site more than likely did not collect these shells from the shore; rather, the presence of marine mollusks at Nahal Hemar Cave indicates the existence of a long-distance exchange network during the PPNB period (Mienis 1988). In addition to its interpretation as a sacred locale, Nahal Hemar is interesting for its wealth of well-preserved organic materials such as cordage, matting, basketry, yarn, fabrics and textiles (Schick 1988). This great preservation of organic materials at the site presents concrete evidence of how these objects were utilized as ornaments in prehistory: two shells were recovered still sewn onto knotted squares, while two additional shells indicate that they had been sewn onto either basketry or textiles (Mienis 1988). Whether shell bead production occurred at the site itself is uncertain. A large proportion of the shells were excavated as complete specimens, and this fact in conjunction with the long distance of Nahal Hemar from the marine sources could indicate that the inhabitants manufactured shell beads at the site from these complete shells, but it is also possible that these complete shells were stored at the site, which is believed to be ceremonial in nature, to later be transported to other sites for manufacturing (Spatz 2008:144).

The Mediterranean Zone Sites

The site of Abu Ghosh is located in the Judean Hills. The architecture at this site is rectilinear in shape, which is characteristic of PPNB Mediterranean zone sites (Khalaily et al. 2003; Khalaily and Marder 2003). Mediterranean Sea specimens dominate the mollusk assemblage. Red Sea shells have been recovered in much smaller numbers (Bar-Yosef Mayer 2003; Mienis 1978; Spatz 2008). Researchers have not been able to conclusively state whether or not shell bead manufacturing occurred at this site owing to incomplete reporting of worked and unworked shells from early excavations there (Mienis 1978) as well as poor preservation conditions noted during later excavations (Bar-Yosef Mayer 2003).

Yiftahel is located in Lower Galilee, Israel. The site is characterized by rectilinear architecture with plastered floors and an economic base that is centered on the cultivation of legumes and gazelle hunting (Garfinkel 1987). Mediterranean Sea shells dominate the mollusk assemblage. Just two Red Sea specimens are present along with a number of freshwater and terrestrial mollusk shells. Despite the small proportion of worked shells, it is generally considered that shell bead manufacturing likely occurred at the site (Bar-Yosef and Heller 1987; Spatz 2008).

Kfar HaHoresh located in the Nazareth Hills of Lower Galilee with its hunting based economy includes a series of rectilinear structures that have plastered floors and fieldstone foundations (Goring-Morris et al. 1994/5; 1995). This site has also been interpreted as a center for ritual activity due to its location and the excavation of ritualistic burials of associated human and animal remains from beneath the plaster floors (Goring-Morris et al. 1994/5). The majority of the shell assemblage can be sourced to the closer Mediterranean Sea and only a small amount originates from the further Red Sea (Goring-Morris et al. 1994/5). Analysis of the shell assemblage did not reveal whether shell beads were manufactured at this site owing to the lack of information on shell conditions in the initial reports of the assemblage (Spatz 2008:155).

The site of Nahal Betzet I is located approximately 15 km from the Mediterranean shoreline where both rectilinear and curvilinear structures have been uncovered (Gopher 1989). The mollusk assemblage of Nahal Betzet I is dominated by Mediterranean Sea shells complimented by terrestrial species (Bar-Yosef Mayer 1997b). In stark contrast to the other Levantine sites, this site lacks any Red Sea shells,

making this assemblage unique among those that have been presented. Owing to the high proportion of worked shells recovered at the site, shell bead manufacturing may have occurred there. Alternatively, Nahal Betzet I with its close proximity to the Mediterranean Sea may have served as a place for the inhabitants to store complete shells as raw material to be exchanged later with PPNB occupants of other sites (Spatz 2008:158).

Red Sea Shell Down-the-Line Exchange Networks

It should be noted that the site of Nahal Betzet I has not been incorporated into this particular model because, as previously discussed, there are no Red Sea shells in the assemblage. Following Renfrew's model, the log of the percentage of Red Sea shells was plotted. As there is no log of zero, this particular assemblage could not be included in the study (Spatz 2008). There appears to be a relatively high correlation between the percentage of Red Sea shells on the logarithmic scale and distance from the Red Sea ($R^2 = .905$) on PPNB southern Levant sites (see Fig. 5.2). As such, this study provides preliminary evidence to support

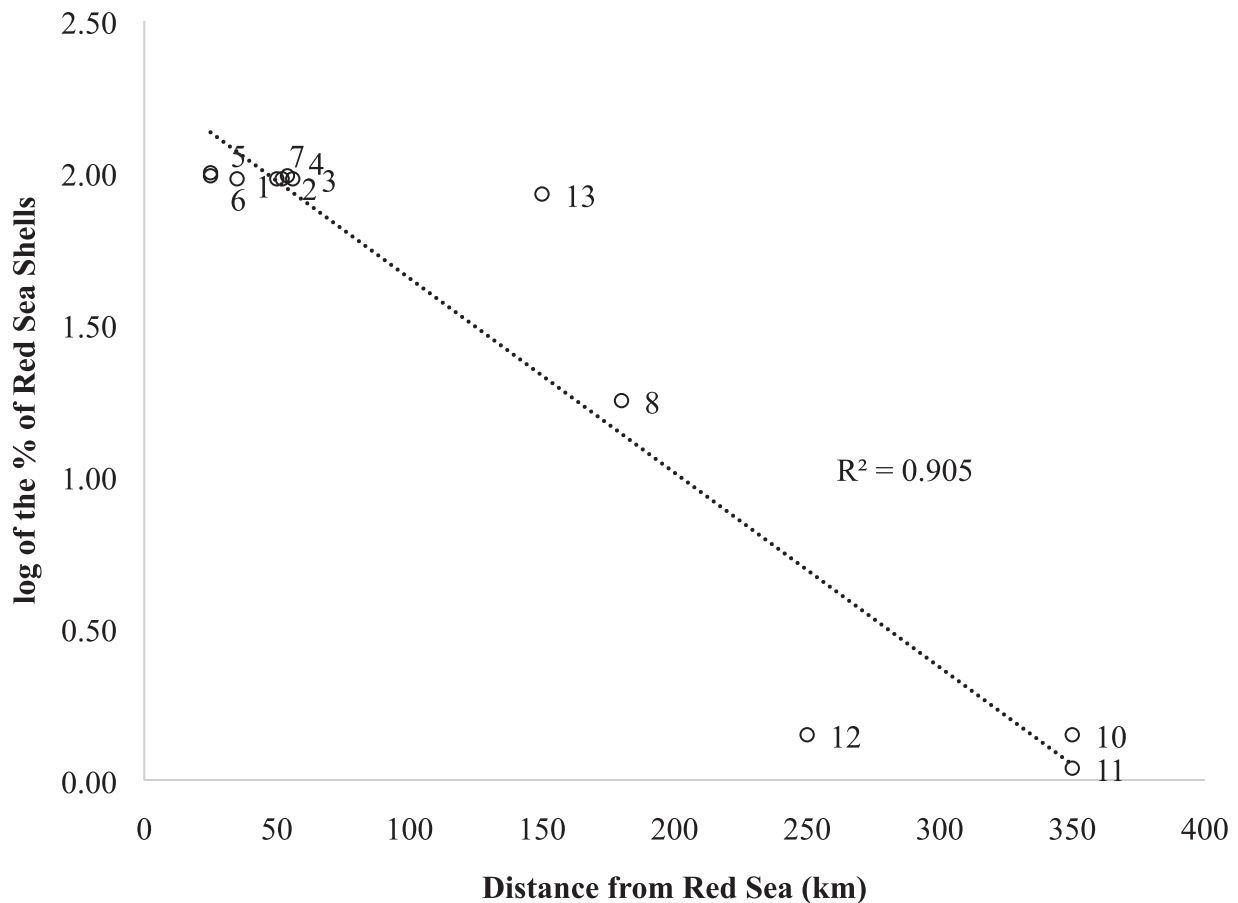


Figure 5.2 Red Sea shells down-the-line exchange model (modified from Spatz 2008:164). 1. Ayn Abū Nukhayla; 2. Ujrat el Mehed; 3. Wadi Tbeik; 4. Gebel Rubsha; 5. Wadi Jibba I; 6. Wadi Jibba II; 7. Abu Madi III; 8. Nahal Hemar; 10. Kfar HaHoresh; 11. Yiftahel; 12. Abu Ghosh; and 13. 'Ein Qadis I.

the hypothesis that Red Sea shells were traded via down-the-line exchange networks in the southern Levant during the PPNB period (Spatz 2008). Unfortunately, there are very few sites located at intermediate distances from the Red Sea (i.e. between 150–200 km) included in the sample. The one site in this study that does fall into this distance range is Nahal Hemar Cave, which seems to conform well to the down-the-line exchange model. As seen in Figure 5.2, the site of ‘Ein Qadis I is one of the outliers in this study. As mentioned earlier, it has a unique shell assemblage. Although ‘Ein Qadis I is closer to the Mediterranean Sea, its assemblage is dominated by Red Sea shells. Thus, the shell assemblage demonstrates that the inhabitants of this site were more strongly influenced by climatic and cultural factors than distance from the source. Thus, the location of ‘Ein Qadis I in the arid zone of the southern Levant in the northern Sinai region must have played a more prominent role in the composition of the shell assemblage than any other factor (Spatz 2008). The fact that not all of the sites conform perfectly to this down-the-line exchange model is not surprising or unique for marine mollusks. In fact, when Renfrew and colleagues formulated this model for obsidian, they noted that “factors other than simple linear distance have indeed affected the utilization of sources. Not only natural barriers but aesthetic considerations, and the adherence to established patterns of trade seem to

have played a role” (Cann et al. 1969:579). Geographic exceptions to this down-the-line exchange network model, such as the site of ‘Ein Qadis I, could actually define boundaries in smaller exchange networks embedded within the larger PPNB interaction sphere.

Mediterranean Sea Shell Down-the-Line Exchange Networks

All 13 PPNB sites are included in this analysis, which revealed a high correlation between the percentage of Mediterranean Sea shells on the logarithmic scale and the distance from the Mediterranean Sea ($R^2 = .825$) (see Fig. 5.3). Therefore, this study provides preliminary evidence that Mediterranean Sea shells were also traded through down-the-line exchange networks in the southern Levant during the PPNB period. Although there are a number of outliers on this scatter plot, none of them are extreme. Once again, the site of ‘Ein Qadis I is an outlier, which is not surprising owing to the aforementioned factors (Spatz 2008).

Down-the-Line Exchange Networks of Finished Red Sea Shell Products

In order to examine the model of a down-the-line exchange network of finished products from either the Red Sea or the

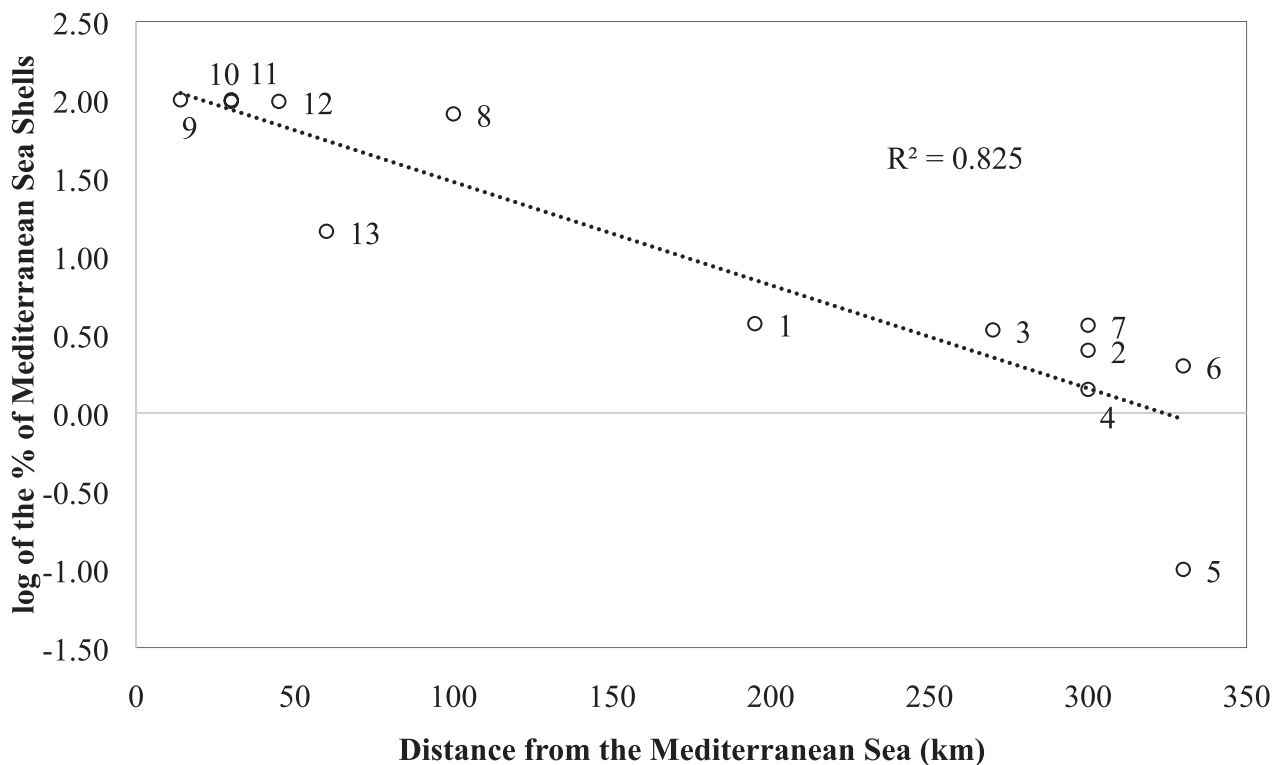


Figure 5.3 Mediterranean Sea shells down-the-line exchange model (modified from Spatz 2008:166). 1. Ayn Abū Nukhayla; 2. Ujrat el Mehed; 3. Wadi Tbeik; 4. Gebel Rubsha; 5. Wadi Jibba I; 6. Wadi Jibba II; 7. Abu Madi III; 8. Nahal Hemar; 9. Nahal Betzet I; 10. Kfar HaHoresh; 11. Yiftahel; 12. Abu Ghosh; and 13. ‘Ein Qadis I.

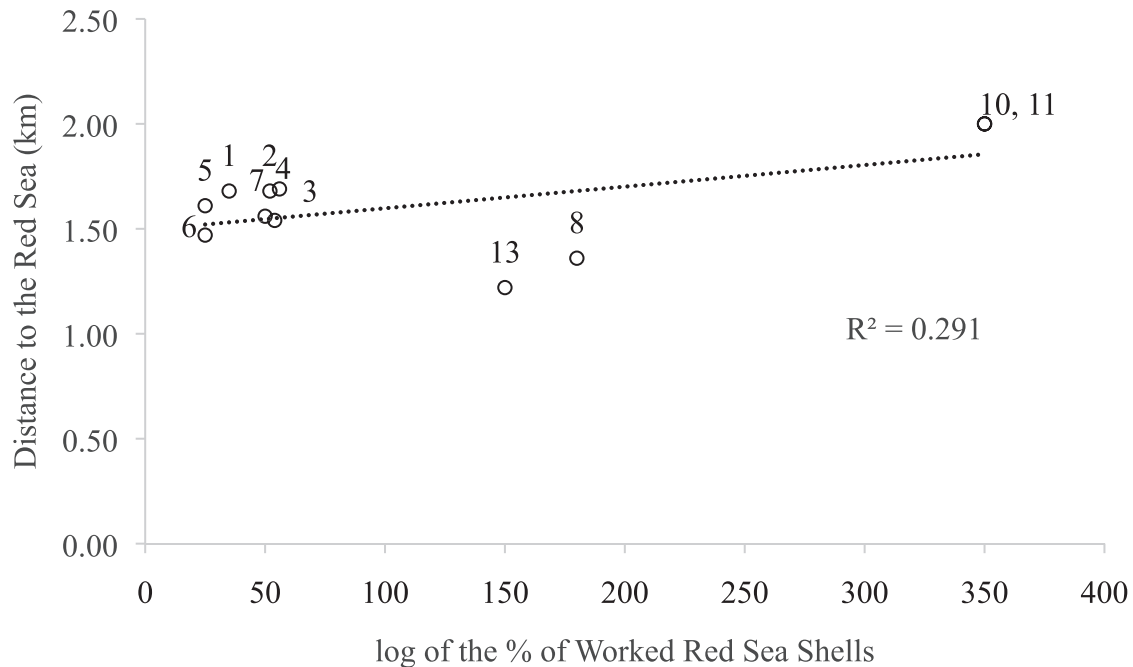


Figure 5.4 Red Sea shells down-the-line exchange as finished products (modified from Spatz 2008:168). 1. Ayn Abū Nukhayla; 2. Ujrat el Mehed; 3. Wadi Tbeik; 4. Gebel Rubsha; 5. Wadi Jibba I; 6. Wadi Jibba II; 7. Abu Madi III; 8. Nahal Hemar; 10. Kfar HaHoresh; 11. Yiftahel; and 13. 'Ein Qadis I.

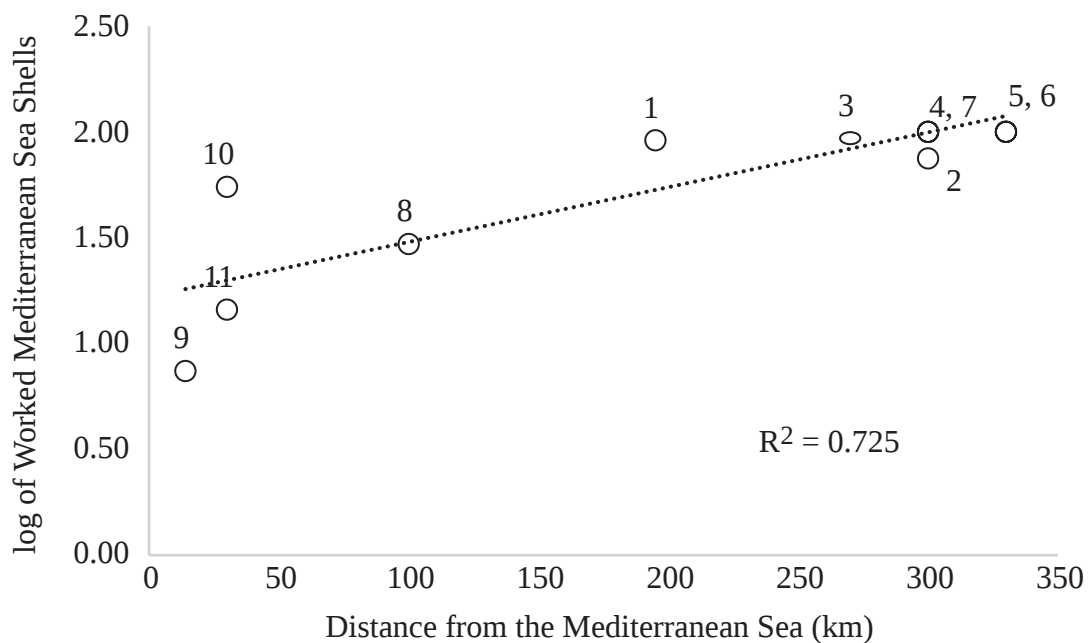


Figure 5.5 Mediterranean Sea shells down-the-line exchange as finished products (modified from Spatz 2008:169). 1. Ayn Abū Nukhayla; 2. Ujrat el Mehed; 3. Wadi Tbeik; 4. Gebel Rubsha; 5. Wadi Jibba I; 6. Wadi Jibba II; 7. Abu Madi III; 8. Nahal Hemar; 9. Nahal Betzet I; 10. Kfar HaHoresh; and 11. Yiftahel.

Mediterranean Sea, the site of Abu Ghosh will be left out of this part of the analysis because of the previously mentioned inadequate reporting of worked shells in the 1978 report. There seems to be no evidence to support the hypothesis that Red Sea shells were exchanged down-the-line as finished products (see Fig. 5.4). Thus, although Red Sea shells seem to preliminarily fit with the down-the-line exchange model, these shells do not appear to have been consistently traded as finished products (Spatz 2008).

Down-the-Line Exchange Networks of Finished Mediterranean Sea Shell Products

In contrast, there is evidence to support the hypothesis that Mediterranean Sea shells were exchanged down-the-line as finished products ($R^2 = .725$, $p = .001$) (see Fig. 5.5). Although there are a number of outliers present in this scatter plot, the greatest variation appears to be near the source. As the distance from the source increases, the percent of worked Mediterranean Sea shells also seems to increase. Thus, as the distance from the source grows, the proportion of worked Mediterranean Sea shells becomes more predictable (Spatz 2008).

In order to further examine the hypothesis that Mediterranean Sea shells were traded as finished products, the frequencies of worked and unworked shells by source were analyzed for those sites that lie more than 200 km from the Mediterranean Sea. The results of this analysis demonstrate that there is a statistically significant difference in the frequencies of worked and unworked shells based on their source for the sites of Ujrat el Mehed ($\chi^2 = 50.407$, $df = 1$, $p < .0001$), Wadi Tbeik ($\chi^2 = 36.077$, $df = 1$, $p < .0001$), and Abu Madi III (Fisher's $p = .003$), while there is not a significant difference in the frequencies of worked and unworked shells by source for the sites of Gebel Rubsha, Wadi Jibba I, and Wadi Jibba II (Spatz 2008:169–170). For all these sites, however, the observed counts of worked Mediterranean Sea shells are greater than the expected counts. Additionally, these three sites have small sample sizes of Mediterranean Sea shells, which may be influencing the analysis. Thus, when the site of Ayn Abū Nukhayla ($\chi^2 = 30.975$, $df = 1$, $p \leq .0001$) is included in this analysis, the majority of the arid zone sites present with a statistically significant difference in the frequencies of worked and unworked shells based on the source. In all the shell assemblages, there is higher frequency of worked Mediterranean Sea shell than would be expected in the arid zone, lending further credence to the hypothesis that Mediterranean Sea shells were exchanged down-the-line as finished products.

Discussion and Conclusions

These analyses present preliminary evidence from these marine mollusk assemblages that both Red Sea and

Mediterranean Sea shells seem to follow a down-the-line exchange model as proposed by Renfrew et al. (1968) for obsidian in the Mediterranean region. It should be kept in mind that this model would only be valid if all of these sites were actually contemporary with one another. As more sites and their marine mollusk assemblages are studied and published with more chronological details, this model should be amended. Of course, the nature of radiometric dating means that there will always be a certain degree of error in the model. One of the faults of this dataset is the lack of sites situated at intermediate distances from the marine sources (i.e. 150–200 km). Incorporating such sites into future datasets will strengthen the model, and it will be interesting to see if this new data will validate the current conclusions. As additional sites such as 'Ain Ghazal, Ba'ja, Basta, Beidha, Es-Sifya, Ghwair II, Mushabi VI, Nahal Issaron and the Wadi Jilat sites (see Fig. 5.1) are excavated and their marine mollusk assemblages are examined and published, they should be incorporated into this model.

Through this examination, the manner in which this trade was carried out can be examined further. In the analysis of the Mediterranean obsidian, the quantities of obsidian are large enough that they could not have derived from a single, one-time visitor. The obsidian was accumulated at these sites over a period of time through persistent and intermittent trips or exchanges. Renfrew et al. (1968:330) argue that a "series of successive transactions down the line seems a reasonable model for a land trade. In the case of a maritime or riverine trade one would not expect an exponential decline of this kind". Renfrew and his colleagues go on to assert that the trade of obsidian was via land rather than by sea or river. Subsequently, the marine mollusk shells in this analysis would likely have been exchanged by land as well if Renfrew's assertion holds true. Although the obsidian exchange in the Mediterranean region conforms to the down-the-line exchange model, it does not necessarily imply any formal mechanism of exchange (Renfrew et al. 1968) such as politically organized trade. The same model would seem to be the case for these marine mollusk shells as well.

It appears from the data that Red Sea shells and Mediterranean Sea shells were exchanged in different forms during the PPNB period in the southern Levant. While there is evidence that Mediterranean Sea shells were exchanged down-the-line as finished products, there is no evidence that Red Sea shells were primarily exchanged down-the-line as finished products. These Red Sea shells could have been exchanged either as raw material or finished products in differing proportions between PPNB period sites. This difference in the basis of shell exchange from the Red and Mediterranean seas reinforces the concept that the cultures centered in each of these locales were fundamentally dissimilar in the way they were organized. There are a number of differences between the PPNB southern Levantine communities in the Mediterranean and arid zones, including settlement patterns, architectural

styles, and subsistence base as well as mortuary practices. These areas differ so markedly that Bar-Yosef and Bar-Yosef Mayer (2002) have studied the excavated and published remains of PPNB farmers of the Mediterranean zone and the mobile foragers of the arid zone and concluded that they fundamentally represent two different types of society. The farmers of the Mediterranean zone comprise “territorially organized, non-egalitarian societies that would fall under the category of ‘tribes’” (Bar-Yosef and Bar-Yosef Mayer 2002:358). In contrast, the mobile foragers of the arid zone consist of “egalitarian societies” (Bar-Yosef and Bar-Yosef Mayer 2002:358). Some of the lines of evidence that were examined in reaching these conclusions, as well as for separating the PPNB Levantine landscape into various preliminary groups include “ceremonial centers, architectural house types, technical aspects of heavy duty tools such as axes and adzes, frequencies of variable types of projectile points, [and] modeled skulls” (Bar-Yosef and Bar-Yosef Mayer 2002:360). Based on the present study, another factor that should be added to this list is the form of shells that were traded via down-the-line exchange, assuming this model holds up to future research.

The Red Sea and Mediterranean Sea shells preliminarily conform well to the down-the-line exchange model proposed for obsidian by Renfrew and his colleagues. This definition of down-the-line shell exchange further illuminates the PPNB interaction sphere, demonstrating that both Red and Mediterranean Sea shells were exchanged between farmers of the Mediterranean zone and mobile foragers of the arid zone. Although these groups may have interacted with one another for other reasons in antiquity, exchange occurred regularly across the landscape, proving that these differentially organized groups were interacting with one another for the purpose of trade. Thus, from various kinds of material evidence, including the marine mollusk shells discussed herein, it is evident that objects and most likely also people were moving throughout the southern Levant during the PPNB period. The geographic patterns of shell utilization clearly demonstrate that there is more involved than merely proximity to a source and down-the-line exchange. In the case of the site of ‘Ein Qadis I, a stronger mechanism than the distance from each source is involved in the make-up of the shell assemblage. Although the site is actually closer to the Mediterranean Sea, the shell assemblage is dominated by Red Sea shells and closely mirrors assemblages from other arid zone sites. In spite of its small size, the shell assemblage from ‘Ein Qadis I corroborates Bar-Yosef and Bar-Yosef Mayer’s (2002) concept of different cultural entities in the Levant. This shell assemblage would indicate a cultural affiliation with the other arid zone sites in the southern Levant. There is also evidence that Mediterranean Sea shells were exchanged down-the-line as finished products. In contrast, Red Sea shells could have been traded as either raw material or finished products.

Thus, these two types of shell were treated differently by the PPNB people of the southern Levant. Owing to the differences between the Mediterranean and arid zones and the fundamentally different social organization in each as proposed by Bar-Yosef and Bar-Yosef Mayer (2002), the differential utilization and exchange of shells (i.e. as raw material or finished products) between these two areas is not surprising.

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Games, Exchange, and Stone: Hunter-Gatherer Beads at Home

Emily Mueller Epstein

Abstract: A diverse set of bone, stone, and shell beads ($n = 19$) recovered from a Late Archaic (1,450–100 cal BP) hunter-gatherer house floor and associated midden in the Great Basin region of North America gives a glimpse into the social lives of those who lived there. Ethnographic records provide a baseline for understanding indigenous bead use during the early twentieth century. Bead life history is also reconstructed from raw material and intra-site spatial associations. Results of this study indicate ethnographic records are applicable to understanding the 800-year-old archaeological subject. This study provides evidence for the complexity and diversity of hunter-gatherer social life.

Introduction

What can we learn about hunter-gatherer social life from beads recovered from a household context? What kinds of beads were recovered from a domestic space? What material sources did people select to shape and perforate for suspension? How did people use beads in a domestic context? Beads are one of humanity's earliest symbolic forms, evidence of activity beyond mere survival (LeMoine 2007). This study explores beads recovered from a house in which people practiced the oldest known economic strategy.

In this paper, I use a life-history approach, or *chaîne opératoire* (Tab. 6.1), on 19 bone, stone, and marine shell beads recovered from a Late Archaic residential occupation located in North America's northern Great Basin (Fig. 6.1).

A *chaîne opératoire* framework may be used in the analysis of sequential acquisition, manufacture, use and abandonment behaviors for a variety of cultural materials, including beads (Pelegrin, et al. 1988; Pigeot 1987). Implied in this approach is an attention to the choices that people made along the way – which raw materials were preferred, what techniques were followed in making beads, what contexts were deemed appropriate for displaying finished beads, and how beads went out of circulation and became part of the archaeological record. I am especially interested in the social behaviors related to the life histories of these beads. I draw upon several types of data, including: metric and non-metric bead data, material identification, extant typologies, ethnographic records, and the spatial distribution of recovered beads. Before I present

Table 6.1 Mortar Riddle bead research questions organized within the *chaîne opératoire* framework.

	Acquisition	Manufacture	Use	Abandonment
Social questions	What material sources are represented?			
What morphological variety exists?	What evidence for manufacture exists?	What information about bead use exists in ethnographic records appropriate for this study and this region?	What is the archaeological context from which the beads were recovered?	
Material evidence	Material identification, metric data	Possible manufacturing debris		Intra-site spatial data
Additional datasets	Bead typologies		Ethnographic records	

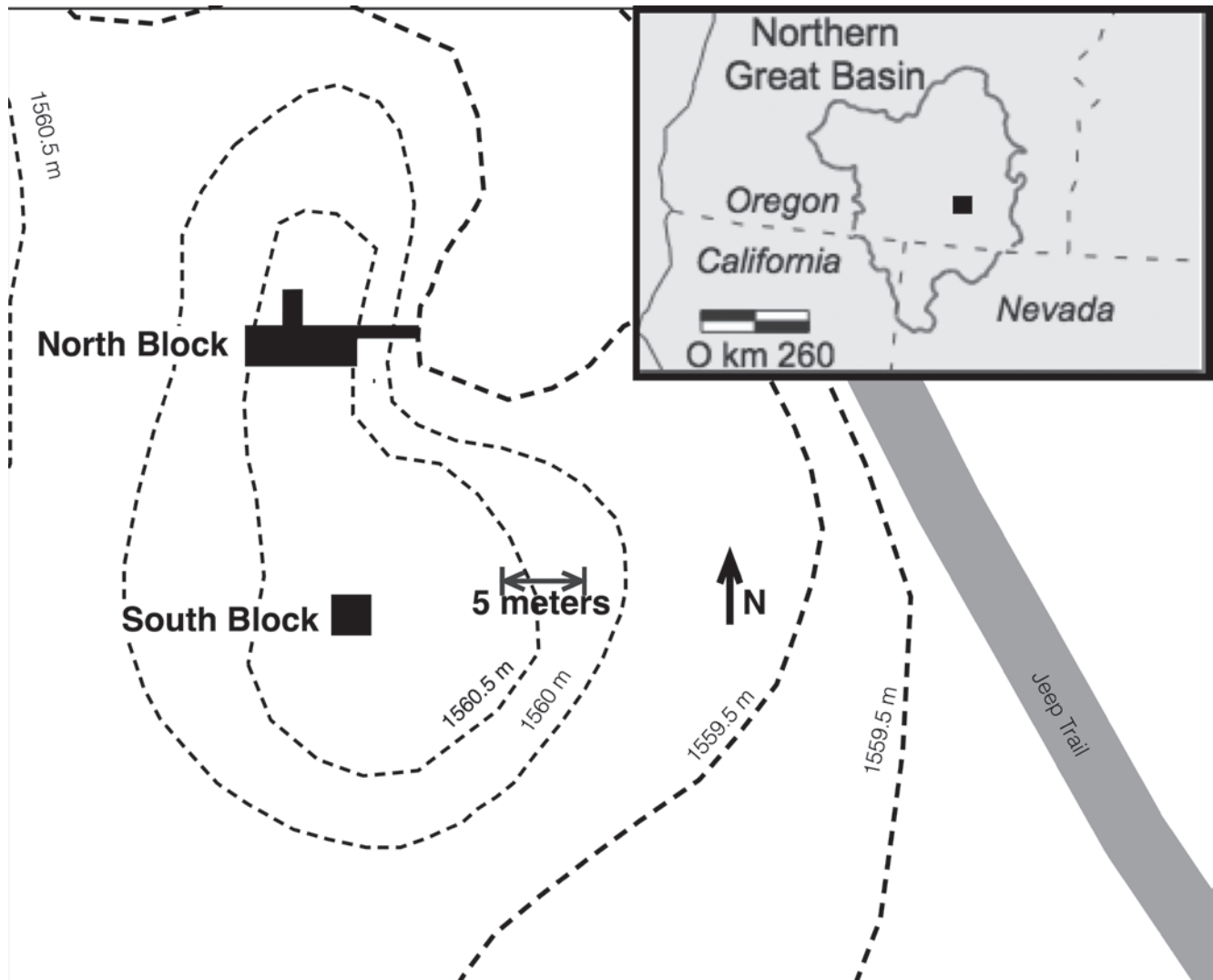


Figure 6.1 Site location map (illustration by Emily Mueller Epstein).

the bead life history, I review the ethnographic records that provide a known baseline from which we can work back to understanding the archaeological subject.

Ethnography

Numerous scholars (e.g. Averbouh 2001:112; Hughes 2012:7–8; Wylie 1985, 1988) warn against the uncritical use of ethnographic data or applying ethnographic data in lieu of archaeological interpretation. This study follows a direct historical approach. I use ethnographic records to establish a baseline for understanding the cultural contexts of pre-contact bead use from which I then assess the archaeological record for evidence of change or continuity over time (cf. Steward 1942; Strong 1940). I then review regional archaeological examples of beads before introducing the bead assemblage recovered from the Mortar Riddle site.

Ethnographic records associate Northern Paiute and Penutian speaking groups (Kelly 1932:72, 186; Whiting

1954:16) with Steens Mountain, where the Mortar Riddle site is located. Other relevant groups include those socially and economically connected to the Northern Paiute and Penutian groups, including Shastan-speakers (Dixon 1907, 1908a, b; Garth 1953) and the Penutian-speaking Modoc (Ray 1963) (Tab. 6.2). Between 1900–1939, these ethnographers collected data among indigenous groups in northern California and southern and southeastern Oregon. Interviews focused on annual subsistence pursuits, housing types, material culture, neighbor relations, trade, social control, life cycle events, shamanism and cultural change. At least 40 individuals were interviewed, with the earliest born in 1845. Interviewees related their parents' and grandparents' experiences, which extended well into the first quarter of the nineteenth century.

Groups acquired beads and a variety of raw bead materials. Marine shell beads were acquired via trade. The Penutian-speaking Klamath also raided other groups for marine shell beads (Spier 1930:216). Locally procured bead material

Table 6.2 Ethnographic records used in this study.

<i>Ethnographer</i>	<i>Ethnography</i>	<i>Publication date</i>	<i>Ethnographic present (field research dates)</i>	<i>Total interviewed</i>	<i>Earliest birthdate among interviewees</i>
Dixon, Roland B.	The Shasta	1907	1900–1904	1+	Unknown
Dixon, Roland B.	Notes on the Achomawi and Atsugewi Indians of Northern California	1908	1903	2	Unknown
Garth, Thomas R.	Atsugewi Ethnography	1953	1938, 1939	13	1853
Kelly, Isabel T.	Ethnography of the Surprise Valley Paiute	1932	1930	7	1855
Ray, Verne F.	Primitive Pragmatists: The Modoc Indians of Northern California	1963	1934	12	1845
Spier, L.	Klamath Ethnography	1930	1925, 1926	4	1855
Whiting, Beatrice B.	Paiute Sorcery	1954	1936, 1937, 1938	1+	Unknown

Note: “1+” is used to indicate the total interviewed numbers for cases where the ethnographer did not explicitly acknowledge or list all those he or she interviewed.

included bone, porcupine quills, reeds, juniper berries, artiodactyl hoofs and phalanges (Kelly 1932:117; Ray 1963:178). The Penutian-speaking Klamath also used a red stone for beads (Spier 1930:215). Shastan-speaking groups used pitch, locally available soapstone and pine nuts for beads (Garth 1953:172, 185; Dixon 1908a:163–165, 1908b:218).

Ethnographic sources do not reveal manufacturing methods in great detail. Obsidian blades were used to carve bone beads (Ray 1963:178). The Shasta-speaking Atsugewi made rectangular beads from abalone, using a “sharpened chisel of deer horn for cutting” (Garth 1953:147). Valued as a form of social currency, beads factored into various life-cycle events, gaming activities, spiritual and healing customs, as well as arbitration. Consuming ground *Dentalium* increased fertility among the Klamath (Spier 1930:57, 139), while Shasta-speaking women drank water with abalone shell scrapings if she wanted a boy and clamshell scrapings if she wanted a girl (Garth 1953:157).

A young Northern Paiute male completing *natsa’-tiha’niu*, the first hunt ritual, must remove his beads (Kelly 1932:80). A menstruating Klamath woman was not allowed to touch her face or head and instead used a stick or bone headed scratcher, the former might be suspended from the neck by threading cordage, sinew or leather through a perforation or around a bulb extending from the scratcher (Spier 1930:69–70, fig. 6). Among the Klamath and Shasta speakers, bride price and marriage related gift exchanges include beads (Spier 1930:46; Garth 1953:163; Dixon 1907:465).

Groups used beads when gaming. Northern Paiute, Penutian, and Shastan-speaking groups all wagered beads during games (Dixon 1907:441–446; Kelly 1932:171, 178; Spier 1930:77, 82; Whiting 1954:76).

Groups used beads in a decorative manner, applied to one’s clothing, person or hair. A Shasta mother kept her newborn’s severed umbilical cord, decorated with beads, in

a piece of buckskin (Dixon 1907:465). Both Northern Paiute and Shasta speakers used beads to decorate cradleboards (Kelly 1932:134; Garth 1953:159). A Shasta-speaking Achomawi widow might wear a deerskin necklace with pitch beads (Dixon 1908b:218).

The social realm of beads included healing and spiritual contexts, as shaman and doctors used beads for their services (Kelly 1932:202; Spier 1930:124; Dixon 1907:484). Northern Paiute and the Shasta-speakers used beads in working with “pains” (Kelly 1932:191; Garth 1953:172). The “pains,” acquired and managed by Atsugewi shaman, resided in bone tubes in the center of a *qaqu*, a feather bundle (Garth 1953:187). The bundle might be stored in a secluded mountain area so that it would not harm someone walking by (Garth 1953:190). “Red beads” are among a long list of spirit agents that bestowed power upon Northern Paiute (Whiting 1954:29).

Beads were used as economic currency for a variety of matters that intersected social life. The Shastan-speaking Atsugewi accepted beads as remittance for various fine-qualifying crimes, including rape, murder and stolen goods (Garth 1953:164, 178, 179, 181). The Surprise Valley Paiute and the Modoc used clamshell beads in settling debts or acquiring other materials (Kelly 1932:117; Ray 1963:178). Klamath paid midwives in beads for their services (Spier 1930:46). Female singers at a girl’s puberty dance were paid a horse and a half-fathom of beads (Spier 1930:68). Individuals paid the shaman with beads (Kelly 1932:202; Spier 1930:124; Dixon 1907:484).

In the ethnographic record, Northern Paiute Indians of the Surprise Valley stored beads and other valuables in their homes (Kelly 1932:182). The Shasta too stored buckskin and beads in large tule baskets within their homes (Garth 1954:149). A Paiute shaman from Surprise Valley was either buried or cremated with his equipment, including

beads (Kelly 1932:191). The Northern Paiute and Shasta-speaking groups both placed beads within the deceased's interment (Whiting 1954:71; Garth 1953:165). In contrast, the Klamath practiced cremation where the deceased are laid upon the pyre with their beads (Spier 1930:293).

These examples demonstrate baseline expectations for the social context of bead use. Ethnographic insights suggest a broad range of social and economic issues are associated with bead use. Northern Paiute, Penutian and Shastan groups used marine shell beads as a form of economic currency. Therefore, these materials represent inter-regional connections over great distances.

Beads were uniformly wagered when gaming, shaman or doctors used beads or bead tubes for healing, and mortuary treatments included the deceased's beads. Culturally distinctive bead use is also evident in variations of life-cycle rituals, taboos and spiritual or healing ceremonies.

These behaviors are indicative of cultural complexity not typically associated with hunter-gatherer life. Indigenous groups continued to negotiate change even while ethnographers visited. How does the archaeological picture vary from the expected baseline? First, research themes concerning Great Basin beads will be reviewed before the Mortar Riddle site and its bead assemblage.

Great Basin Beads and their Archaeological Interpretation

Archaeologists report bone, shell, and stone beads recovered from numerous pre-contact sites in North America's Great Basin. Research questions, however, focus on trade and exchange for which marine shell beads are key (e.g. Eerkens and Spurling 2008; Hughes 2011; Hughes and Bennyhoff 1986; Jenkins and Erlandson 1996; Jenkins and Wimmers 1994; Jenkins et al. 2004). The Bennyhoff and Hughes (1987) typology, based on their analysis of 5,400 *Olivella* shell beads recovered from radiocarbon-dated lenses at 81 different sites across California and the western Great Basin, is frequently used as a relative dating method for *Olivella* spp. artifacts recovered from both regions. The revised typology by Milliken and Schwitalla (2012) includes the addition of recently identified bead types.

Bennyhoff and Hughes (1987:154) offered a "first approximation" for bead manufacturing center locations across California and the Western Great Basin based on site recovery and marine shell source locations. Peak exchange between California and the Great Basin occurs between 4,000 and 2,200 cal BP and, after a sharp 900-year decline, exchange between the two regions increases again between 1,250–450 cal BP (Bennyhoff and Hughes 1987:161). Northern Great Basin *Olivella* spp. bead frequencies compare favorably to the Bennyhoff and Hughes (1987) model (Largaespada 2006).

Stone and bone bead typologies do not exist, Gifford's (1940) regional inventory of bone artifacts from

California notwithstanding. While not a typology, Jenkins et al. (2004:260) used metric data to standardize their morphological "ring" vs. "tube" categories in addition to including taxonomic identifications for bone beads recovered from northern Great Basin sites in Oregon.

The importance of marine shell beads in Great Basin Archaeology is plain; *Olivella* spp. bead types, in particular, are valued as chronological indicators and as evidence for long-distance trade networks (Hughes and Bennyhoff 1986). Understanding bead functionality in social realms remains an open avenue of research. In the next section, I review the archaeological context from which the Mortar Riddle site beads were recovered.

Mortar Riddle Archaeology

Mortar Riddle (35HA2627) is an Archaic 1,890–100 cal BP site located in North America's northern Great Basin at 1,561 m (5,120 ft) on Steens Mountain. The Late Archaic period in the northern Great Basin is characterized by the addition of the bow and arrow to the hunter-gatherer tool kit, variability in group mobility, the addition of rock-borders to wickiup houses, and material culture typically associated with the Plains, Plateau, and Coastal regions. The site is well within the Northern Paiute cultural area (Steward 1938; Fowler and Liljeblad 1986) and ethnographic records (Kelly 1932; Spier 1930; Whiting 1954) indicate at least three different groups – the Surprise Valley Paiute, the Klamath and the Harney Valley Paiute – visited Steens Mountain prior to and around the time of Euro-American incursion. Steens Mountain is threaded with river systems, most of which drain into the relatively well-studied Harney Basin (Fagan 1974; Musil 1992; Oetting 1992; O'Grady 2006; Wigand 1985). How the archaeology of this mountain range, a so-called "hinterland," is connected to the broader region requires synthesis (Jenkins et al. 2010:25).

The Mortar Riddle site is on a southeast facing river terrace from which site occupants had prime access to a wide variety of floral and faunal resources. Fresh water, the limiting resource within the broader high desert environment, is a mere 100 m away in the perennially flowing Little Blitzen River. The site's 10,000 sq m surface includes mounded earth features densely scattered with flaked and ground stone tools. Ground stone mortars visible on the site's surface total 65 in number.

Approximately 20 sq m of sediment was excavated from the site's earthen mounds over the course of five field seasons. Of the 19 beads considered here, 16 were recovered from the largest mound in a hard packed, house floor lens (Fig. 6.2). One additional bead was recovered from a midden and hearth feature. Wood charcoal associated with the house floor lens produced a radiocarbon age of 920 ± 40 BP (Beta-239165; wood charcoal) and a 2σ calibrated age range of 930–740 cal BP. We exposed a portion of the hard packed, house floor lens

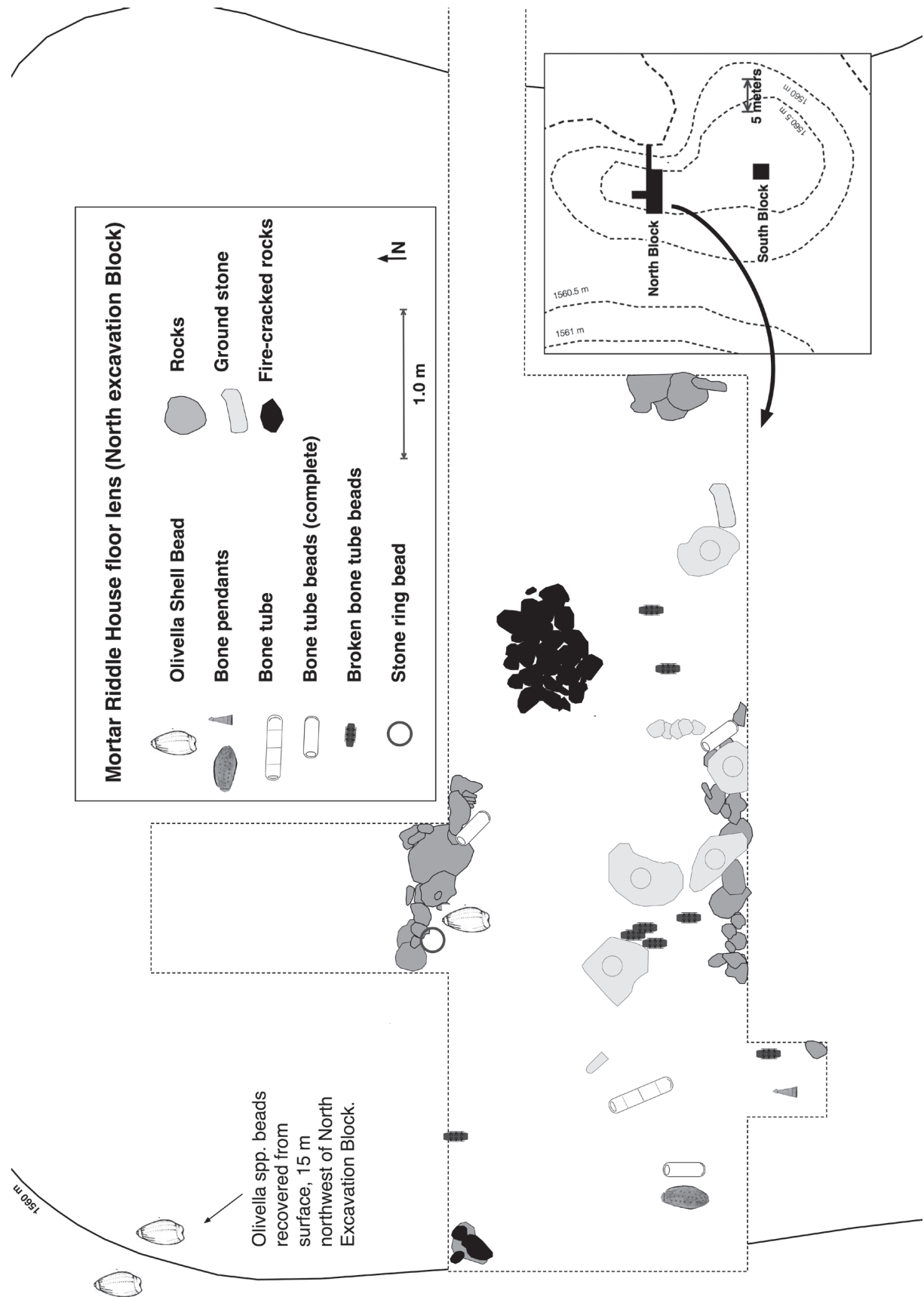


Figure 6.2 Mortar Riddle site plan, house floor lens detailed. Midden context pictured in inset. Bead size increased to improve visibility (illustration by Emily Mueller Epstein).

in the North Block excavation unit. The floor includes a large hearth feature, stone alignments suggesting wall supports, ground stone mortars, numerous hand stones and hundreds of flaked stone tools, as well as beads and bone game pieces. It is useful to consider four zones of the floor; the hearth area, large ground stone mortars aggregated along the southern wall, the northern rock wall support feature, and the western personal/sleeping area. I argue the last mentioned living space is indicated by the lack of large site-furniture such as large rocks or ground stone artifacts and the presence of a smaller interior hearth. This house floor assemblage is the focus of this paper. Another midden and hearth feature, located 15 m south of the house floor, produced a relatively poorly organized cultural matrix containing a hearth, surrounded by burned and gnawed bone, chipped and ground stone artifacts, one bone game piece and a stone bead (Mueller 2007).

Epstein's (2007) analysis of the flaked stone tool assemblage indicates site occupants hunted and engaged in a wide variety of floral and faunal processing behaviors. Geochemical analysis of flaked stone artifacts indicates raw material was mostly acquired from an obsidian source 35 km from the site, but also from other sources up to 100 km away. People ranged the greatest distances for raw lithic material 900–500 cal BP (Epstein 2007:70). At the same time, the climate transitioned from one of greater effective moisture to one of reduced effective moisture and periodic droughts (Mehring 1987; Wigand 1985:199). The bulk of the analyzed Mortar Riddle zooarchaeological assemblage is associated with the house floor lens, providing evidence that Mortar Riddle occupants relied heavily on large game as well as rodents, such as marmot (Mueller 2007). Bone artifacts, including beads, game pieces and those of unknown function, were spatially associated with the house floor lens. Carnivore gnawed bone was typically associated with the midden feature. Evidence exists for hunting, cooking, gaming and non-subsistence (artistic) activities, behaviors attributable to a multi-gendered and multi-aged household group.

The archaeological context of Mortar Riddle bead abandonment and possible use is a domestic social space.



Figure 6.3 Left: Type A1b Medium Spire-lopped *Olivella* sp. bead (pictured: artifact #06-138-1). Right: Type F3b Small Saddle *Olivella* sp. bead (artifact #04-935) (photo by Brooke L. Drew).

A description of the beads precedes a discussion concerning the applicability of the ethnographically derived expectations for social context.

Mortar Riddle Beads

The Mortar Riddle bead assemblage reported herein totals 19 specimens (Tab. 6.3). Material identifications preceded efforts to identify represented taxa. The 19 beads comprise three broad material categories: marine shell, stone and bone (Fig. 6.3–6.6), most of which are associated with the house floor lens dating to 930–740 cal BP. I determined marine shell bead types and chronological association based on morphometric characteristics defined in Bennyhoff and Hughes (1987) and Milliken and Schwitalla (2012:7). When applicable, I characterized bead shape following Jenkins and Wimmers (1994:116) and Jenkins et al. (2004:260); “tube” shaped beads are those with a diameter measuring less than the bead’s length multiplied by 0.3 plus the bead’s length, and “ring” shaped beads are those with lengths measuring less than or equal to the diameter multiplied by 0.3 plus the bead’s diameter.

There are a total of three marine shell beads identified within the Mortar Riddle bead assemblage. One *Olivella* sp. bead (Fig. 6.3), recovered in association with a stacked rock alignment at the north end of the exposed house floor lens, is a Type F3b, Small Saddle (Bennyhoff and Hughes 1987:130–132; Milliken and Schwitalla 2012:42). Type F3b *Olivella* sp. beads are associated with sites in northeastern California and northwestern Nevada 2,750–1,250 cal BP, predating the Mortar Riddle house floor lens.

Two *Olivella biplicata* shell beads were recovered from the site’s surface, their relative rarity in the immediate area



Figure 6.4 Left: Steatite bead (artifact #04-936), associated with house floor. Right: Bead of unknown stone material (artifact #05-141) (photo by Brooke L. Drew).

justifies mentioning them here. The two Type A1b Medium Spire-lopped beads (Bennyhoff and Hughes 1986:118) were collected from the surface about five meters northwest of the house floor. When *Olivella* spp. beads are found in northern Great Basin sites, Type A1 beads are the most common form of *Olivella* spp. identified (cf. Jenkins et al. 2004:254).

Stone beads recovered from Mortar Riddle total two. One steatite bead (Fig. 6.4) (Artifact #04-936), also recovered in association with a stacked rock alignment at the north end of the exposed house floor, is a ring style bead (Jenkins and Wimmers 1994:116; Jenkins et al. 2004:260). The steatite material became visible after the bead was submerged in water and exposed to ultrasonic frequencies. Steatite sources are roughly 360 km west of Mortar Riddle in southwestern Oregon (Loy 2001:142–143). The second stone bead is also a ring style bead (Jenkins and Wimmers 1994:116; Jenkins et al. 2004:260), recovered from the midden feature about

10 m south of the house floor lens. Petrographic microscopy provided a clear view of a single grain of sand in the wall of the perforation column, though the raw material remains unidentified.

Bone is the most frequently used raw material for beads (Table 6.3). Bone beads total 14; ten likely represent mammals, one a bird and three beads represent unidentified vertebrates. Ten bone beads are “tube” beads and one is a “ring” bead (Jenkins and Wimmers 1994:116; Jenkins et al. 2004:260). Two artifacts exhibit modifications that may have allowed suspension as pendants. Five beads are complete (Fig. 6.5) and nine beads are broken (Fig. 6.6).

The largest bone tube (Fig. 6.5, Artifact # 05-38) compares favorably with the middle-diaphysis region of a *Canis latrans* (coyote) left femur. The linea aspera is visible on the posterior surface. One large score mark, 1 mm wide, encircles the tube mid-shaft, with less prominent scoring at

Table 6.3 Mortar Riddle bead assemblage. Sources: Bennyhoff and Hughes 1987; Jenkins and Wimmers 1994; Jenkins et al. 2004; Milliken and Schwitalla 2012.

Catalog #	Material	Taxa	Element	Wt (g)	Length (mm)	Width*(mm)	Angle index	Morphometric or typological classification	Condition
05-141	Stone	N/A	N/A	0.03	1.5	4.5		Ring	Complete
04-936	Stone	N/A	N/A	0.16	3.5	6.5		Ring	Complete
06-138-1	Shell	<i>Olivella biplicata</i>	Complete	0.66	13.75	9		A1b – Medium Spire Lopped	Complete
04-935	Shell	<i>Olivella</i> sp.	Whorl wall	0.03	5.25	5	0.7586	F3b – Small Saddle	Complete
10-1206	Shell	<i>Olivella biplicata</i>	Complete	-	15	9		A1b – Medium Spire Lopped	Complete
04-934	Bone	Mammal III	Diaphyseal	0.23	13.5	4.5		Tube	Complete
04-426	Bone	Mammal II	Diaphyseal	0.04	8.5	2.5		Tube	Complete
05-38	Bone	Mammal IV – cf. <i>Canis</i> sp.	Left femur	9.1	88	14.5		Tube	Complete
05-295	Bone	Mammal V	Diaphyseal	0.66	24	10.5		Pendant	Complete
05-515	Bone	Mammal II	Diaphyseal	0.01	6	2		Tube	Complete
07-112-3	Bone	UNID – vertebrate	Diaphyseal	0.1	13.5	6		Pendant	Broken
04-558/560	Bone	Mammal X	Diaphyseal	0.09	12	4		Tube	Broken
07-108	Bone	UNID – vertebrate	Diaphyseal	0.09	11.5	5		Tube	Broken
07-171	Bone	Mammal III	Diaphyseal	0.1	1.5	7.25		Ring	Broken
06-39-10	Bone	Mammal V	Diaphyseal	0.28	16	N/A		Unknown	Broken
04-679	Bone	cf. Aves	Diaphyseal	0.37	27.5	5.5		Tube	Broken
04-558/560	Bone	Mammal III	Diaphyseal	0.12	18	6		Tube	Broken
04-530	Bone	UNID – vertebrate	Diaphyseal	0.07	6.5	6		Tube	Broken
04-679	Bone	Mammal II	Tibia?	0.04	7.5	2.75		Tube	Broken

Note: Bead shape characterized as “ring” or “tube” following Jenkins and Wimmers (1994:116) and Jenkins et al. (2004:260). *Olivella* shell bead types follow Bennyhoff and Hughes (1987) and Milliken and Schwitalla (2012:7).



Figure 6.5 Complete Mortar Riddle bone beads, left to right. Top row: bone tubes (artifact #04-426, #04-934, #05-515) and one pendant (artifact #05-295). Bottom row: large bone tube (artifact #05-38) (photo by Brooke L. Drew).

either end of the tube. It seems unlikely that the artifact was in the process of being snapped into smaller beads, as the ends are finely polished. Given the modified nature of the large bone tube, I restricted the identification to *Canis* sp. The bone tube was recovered within the house, near other finished bead artifacts in the far southwestern floor area.

Other complete bone tube beads (Fig. 6.5, #04-426, #04-934, #05-515) most likely represent the long bone shaft fragments of smaller mammals, as the texture and thickness of the compact bone is far too robust to represent other taxa. The bone tube beads all exhibit evidence for scoring. Artifact #04-934, recovered near the stone alignment in the northern portion of the exposed house floor, exhibits smoothly polished ends. Artifact #04-426 is a very small and crudely fashioned bead recovered from the same wall support, visible at the north end of the house floor. A very small and crudely manufactured bone tube bead (Artifact #05-515) that had been exposed to thermal alteration was recovered in the far southwestern house floor area.

A single piece of large mammal (e.g. deer) bone debitage appears to have been fashioned into a pendant (Fig. 6.5, Artifact #05-295) as cordage or sinew could be bound within the groove, visible near the proximal margin, allowing for suspension. Drilled into one surface are 23 individual indentation “dots” while a faint indentation is visible on the opposing surface. Two other bone game pieces were recovered from the site, but lack any indication of having been perforated or scored for suspension.

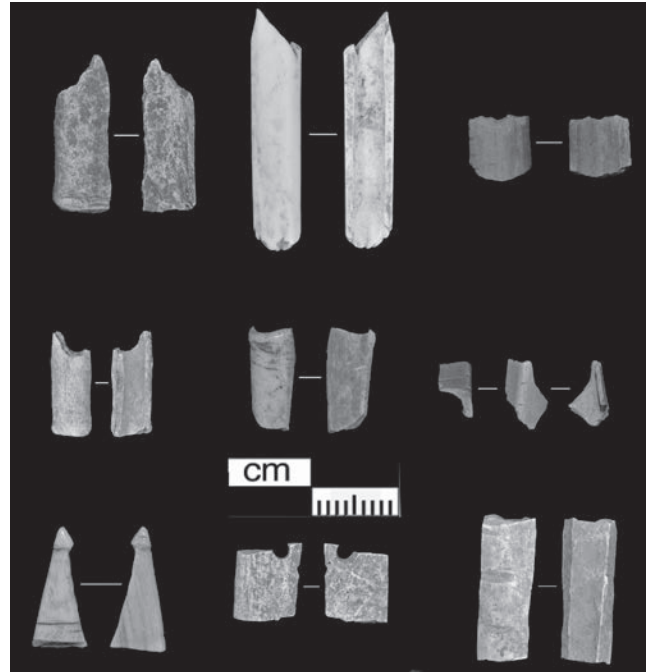


Figure 6.6 Broken Mortar Riddle beads and pendant, left to right. Top row: tube beads (artifact # 04-413, #04-679, #04-530). Middle Row: tube beads (artifact #04-629, #07-128, #04-494). Bottom Row: pendant (artifact #07-112-3), ring (artifact #07-171), tube (artifact #06-39-10) (photo by Brooke L. Drew).

Broken bone beads (Fig. 6.6) total nine. One artifact (Artifact #07-112) appears to be another pendant with a proximal element allowing for suspension. Near the distal margin of the pendant are two transverse score marks, between and above exist fainter oblique hatch marks. A transverse break occurred just below the score mark at the artifact’s distal end. The pendant was recovered from the southern margin of the house floor lens near other formal bone bead artifacts, such as the pendant gaming piece.

One broken ring bead (Fig. 6.6, Artifact #07-171) exhibits texture that compares favorably with mammalian compact bone texture. The ring bead was exposed to thermal modification and drilled from the bone’s interior towards the exterior compact bone. The bone ring bead was recovered just south of the hearth feature and near ground stone mortars. Another thermally altered and broken tube bead (Fig. 6.6, Artifact #04-530) was also recovered south of the hearth feature and just west of Artifact #07-171. Two score marks are evident on the tube’s side.

Four beads (Artifacts #04-494, #04-679, #04-629, and #04-413) were recovered within a cluster of large ground stone mortars. Artifact #04-494 is a small burned diaphysis fragment with two prominent score marks. Artifact #04-679 was broken longitudinally as well as in the transverse, but likely represents a bird species.

Artifact #04-629 is a longitudinally broken bead, likely representing a mammal, with pronounced scoring and a rubbed end. Artifact #04-413 likely represents a medium mammal bone with pronounced scoring and a lip near the scored edge.

One broken bead artifact (Artifact #06-39, Fig. 6.6) is a bone tube fashioned from thick compact bone with very little curvature. The artifact was subjected to thermal modification. Measuring the specimen's diameter was impossible because the artifact was so thin. Artifact #07-108 (Fig. 6.6) is a small longitudinally fractured bead with several score marks observable near a rounded end. Bone texture and color did not permit taxonomic identification.

There are a total of 19 beads associated with a 930–740 cal BP household. Bone is the most frequently used raw material, followed by marine shell, and stone. *Olivella* sp. and steatite are available from sources located in excess of 300 km from Mortar Riddle. Bone beads were likely fashioned from local mammalian and avian taxa. Morphological types include two pendants, one ring, and 11 tubes. Six bone tube beads (Artifacts #04-413, #04-679, #04-530, #04-629, #07-128, #04-494) are longitudinally broken or exhibit a combination of longitudinal and transverse breaks, while four are complete and whole. The bone ring (Artifact #07-171) and one bone pendant (Artifact #07-112-3) are also considered broken. Manufacturing accidents, other human error or taphonomic factors may have caused beads to break, but this study did not focus on the technical aspects of bead breakage.

Spatial distribution of beads is patterned. Whole bone beads, the stone bead and the Type F3b2 *Olivella* sp. bead were recovered in spatial association with the rock wall alignment north of a food processing area or in the far southwestern floor area. The pendants and the large bone tube were recovered in the same location, one that may have served as an area for more private activities, like sleeping or storing personal objects. Likewise, people may have kept whole beads near personal sleeping areas to keep them away from locations of more active pursuits, such as the hearth and ground stone processing areas.

Discussion

Beads were recovered in four major areas of the house floor: near the hearth area, near ground stone aggregated along the southern wall, near the northern stacked rock wall support feature, and in the western personal/sleeping area. Drawing upon multiple datasets described in previous sections, I review bead life history below according to the behavioral house floor space from which they were recovered.

Two broken bead fragments (Artifacts #07-171 and #04-530) were recovered near the hearth feature. Both bone beads were likely manufactured from locally available taxa. According to morphometric measurements, Artifact

#07-171 is classified as a ring and Artifact #04-530 as a tube. Observing broken beads near the ground stone mortars and hearth feature is not surprising since the space was likely one used for a high level of foot traffic, processing and cooking activities.

Beads recovered in proximity to the ground stone aggregation along the southern wall total five. Four broken beads (Artifacts #04-413, #04-629, #04-679 and #04-494) were recovered in close spatial proximity to one another, nearly encircled by ground stone mortars, while one complete bead (Artifact #04-626) was recovered in association with the southern rock wall support, a large ground stone mortar and an aggregation of ground stone manos. Again, broken beads near high use areas are not surprising.

Three complete beads, fashioned from bone, marine shell, and stone were recovered in association with the northern wall support feature. One complete bone tube bead (Artifact #04-934) represents a mammal. The Small Saddle Type F3b *Olivella* sp. bead, discussed above, is associated with northeastern California and northwestern Nevada sites ca. 2,750–1,250 cal BP (Bennyhoff and Hughes 1987:130–132; Milliken and Schwitalla 2012:42). Ethnographic insights remind us that beads, especially marine shell beads, were valued as a currency, facilitating a range of economic and social behaviors. The steatite bead (Artifact #04-936), like the marine shell bead, is indicative of associations with interregional networks.

Six bone beads were recovered in the personal/sleeping area in the western portion of the exposed house floor lens. One broken bead (Artifact #06-39) was observed and recovered from an area between the smaller interior hearth and the northern wall support. The bead had been thermally altered. One broken tube bead (Artifact #07-108) and one pendant (Artifact #05-295) were recovered in proximity to the southern aggregation of the ground stone mortars and wall support feature. The pendant fragment is remarkably similar to those pictured in Spier (1930:69–70; Fig. 6.6). Complete artifacts recovered from the area lacking site furniture toward the southern end of the personal/sleeping area included one small burned tube bead (Artifact #05-515), the large bone tube (Artifact #05-38) and a complete pendant (Artifact #05-295). Ethnographic data indicate shaman used larger bone tubes for containing or understanding powerful energy sources. The large mammal pendant exhibiting drilled holes on one side provides evidence for gaming activities in the personal/sleeping area.

Drawing upon multiple lines of evidence, a more vivid picture of Mortar Riddle household life begins to emerge. Ethnographic insights allow us to consider a long list of social events and activities to enrich our picture of how beads functioned during pre-contact times. One can easily imagine a woman processing food while her baby played with beads dangling from a cradleboard or stitched to her dress, causing one to accidentally drop. A shaman may have

made a bedside visit to an ailing patient with his tube. Friends may have gathered to play the bone game. That whole artifacts and those with interregional trade value were recovered well within the Mortar Riddle house, in the sleeping/personal space, area is not surprising; inhabitants made arrangements to store fragile and valuable beads away from food processing activities, along with other formal bone tools and game pieces.

Foraging groups from North America's Great Basin along with Australian aboriginal groups and the arid Savannahs of Southern Africa are often cited examples of the foraging strategy (e.g. Kelly 1995). Those with limited knowledge of the foraging strategy may possess a rather Hobbesian view of what the foraging life entails, including assumptions that such groups have limited and simple cultural frameworks. This study is another reminder that the social context of forager life is complex and nuanced.

Given the antiquity of the subject beads and the ethnographic field research dates, the applicability of the ethnographic data appears to be in excess of 800 years. Mortar Riddle site beads were recovered from a lens dated to 930–740 cal BP. Baseline expectations for the social context of bead use were derived from various ethnographic sources, based on field research conducted between 1900 and 1939. Social contexts for bead use presented in this study indicate long-term social continuity. The consulted records document group-specific knowledge of bead use, including the social context, which survived the disastrous effects of Euro-American encroachment.

This study is one that may be applied to bead assemblages recovered from sites in proximity to Steens Mountain and those in the broader region. Applied to the former, one may investigate change in the social context of bead use during the last 500 years, a period for which the local archaeological record lacks synthesis and the material is most susceptible to illicit collection. Inter-site comparisons of represented materials or bead morphology may be used to assess social aggregations vis-à-vis bead use at a regional scale. Conversely, one may investigate whether social convergence related to beads existed in spite of other differences.

Conclusions

The modest Mortar Riddle Site bead assemblage exhibits a wide morphological and raw material diversity. A general conformity with baseline ethnographic data reveals a wide range of social contexts in which we can imagine their use, ranging from life-cycle events, health treatments, gaming, arbitration, economic currency and adornment. Mortar Riddle was connected to well-established trade networks, and future research may clarify regional social patterns. The mere existence of beads suggests hunter-gatherers allocated energy toward goals with value(s) beyond net kilocalories or survival. Multiple lines of evidence suggest that beads recovered from Mortar Riddle were not just for show.

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Part 2

Audio and Visual Social Cues

The Natufian Audio-Visual Bone Pendants from Hayonim Cave

Dana Shaham and Anna Belfer-Cohen

Abstract: *The Natufian archaeological entity in the Levant (15,000–11,500 cal BP) shows evidence of unique behavioral and cultural phenomena, reflected in its material remains. The various lines of evidence were recognized as valid indicators of growing social complexity. Decorated burials are a specific Natufian practice identified in several sites. At Hayonim Cave some skeletal remains had been richly adorned with ornaments. The present case study deals with the decorations from Grave VII at Hayonim Cave that comprise tear-shaped pendants made from gazelle bones. A specific arrangement of the pendants around the pelvis of H.9 suggests they were part of an object that potentially had an acoustic effect. The study of these pendants through a comparative approach of art research along with musicological-organological considerations provided interesting insights. An articulated visual-artistic and acoustic-musicological feature can be defined which also articulates with specific cultural behavior related to the production of these pendants. Further discussion illuminates the role of arts as a particular cultural mechanism in the formation of social complexity.*

The Background

The Natufian archaeological entity (ca. 15,000–11,500 cal BP) shows unique cultural phenomena, reflected in its material remains (e.g. durable stone-built structures, intense occupation layers, graveyards, rich bone industries etc.). Altogether these various lines of evidence were recognized as an indication of growing social complexity – part of the social transformations that accompanied the transition from Paleolithic to Neolithic life ways (Bar-Yosef 1983, 2002; Belfer-Cohen 1991a; Garrod 1957; Hayden 2004; Valla 1995).

Prominent among the Natufian material remains is what has been considered in the eyes of modern researchers as evidence for intense and constant artistic activity, largely absent from the archaeological record of preceding periods in the Levant (Bar-Yosef 1997; Belfer-Cohen 1988a; Belfer-Cohen and Bar-Yosef 2009; Garrod 1932; Valla 1999). The Natufian art objects can be divided into several categories: freestanding items (like figurines or incised slabs), decorated tools and ornaments.

Decorated burials are a specific practice that has been identified in several Natufian sites, where some of the

skeletal remains, mostly in Early Natufian contexts, had been richly adorned with ornaments made of scaphopod shell (or tusk shell, sometimes referred to as *Dentalium*), bones or animal teeth, for example in el-Wad Cave (Garrod and Bate 1937; Weinstein-Evron 1998), Eynan (Perrot and Ladiray 1988) and Hayonim Cave (Belfer-Cohen 1988c). This practice triggered enquiries into the socio-cultural aspects of the Natufian, such as: (a) the question of social stratification (e.g. Byrd and Monahan 1995; Wright 1978); (b) socio-economic aspects concerning the manufacture of ornaments, their use and distribution (e.g. Le Dosseur 2006 and references therein); (c) the meaning of the differences observed in the various chronological phases (e.g. Belfer-Cohen 1988b; Stordeur 1991); and (d) the implication of inter-site variability of ornaments for issues of group identity (e.g. Noy and Brimer 1980; Pichon 1983; Stordeur 1981).

However, the ornamental items themselves have inherent characteristics of their own – their artistic qualities, particular contexts and arrangements and, as will be suggested herein, in some cases they have, besides the apparent visual aspect, acoustic qualities.

The Study

Framework – An Aesthetic Approach

The present study deals with a group of bone pendants that adorned a Natufian burial at Hayonim Cave (Fig. 7.1). It is based on research that was developed to adjust methods inherent in art history for the study of Natufian art (Shaham 2013). Accordingly, an inductive approach and a comparative method accompanied formal descriptions and style analyses. It enables evaluation of the artistic dimensions of objects, as well as the identification of distinct styles and various modes of art creation. In previous studies, the present authors had defined at least two modi in Hayonim Cave: an “action-modus” and a “formal modus” (Shaham and Belfer-Cohen 2013). A group of incised stone and bone items belonging to the “action modus” variety shares visual qualities that give an impression of an active depiction; it seems the very action of depiction carried even more importance than the final result, which is almost unseen. The “formal modus,” on the other hand, is characterized by geometric organized compositions. Items in this group are more pre-planned, clear and coherent. These traits characterize a more conventional creation; they also present simpler structure for perception. Thus, the visual attributes of art objects from Hayonim Cave reflect creation in distinct social activities, portray different interactive values, and were (and still are) perceived by different means.

Location and Context – Hayonim Cave

Hayonim Cave is located in western Galilee, Israel. Two series of excavations were carried out on site (for history of excavations, see Bar-Yosef et al. 2005). The Natufian was the last prehistoric occupation in the cave, capping Mousterian, Aurignacian and Kebaran habitations. The rounded structures and the built graves distinguish the Natufian layer from the preceding layers. The very small structures (unsuitable for living) along with special installations, the abundance of graves and the meager lithic assemblage, indicate that the cave was used for specific, mostly non-domestic activities (Belfer-Cohen and Bar-Yosef 2012). Most of the Natufian finds from the first series of excavations (1964–1979) were published by A. Belfer-Cohen (1988c, 1991b), while the material from the second series of excavations (1992–2000) is yet to be published.

Beads and pendants are abundant in the Natufian levels of Hayonim Cave, predominant are scaphopod shell beads and among a variety of other ornaments are beads made from partridge tibio-tarsus that have been reported in small numbers from only few other sites (Belfer-Cohen 1988c). The most common types of pendants are tear-shaped bone pendants and perforated fox teeth, found in other Natufian assemblages as well, though in frequencies that vary from site to site (Belfer-Cohen 1988c). Certain types

of jewelry are rare in Hayonim Cave, or absent altogether (e.g. beads made from gazelle phalanges; Belfer-Cohen 1988c). Besides inter-site variability of jewelry types and frequencies, diachronic variations are also evident at Hayonim Cave (Belfer-Cohen 1988c). In Early Natufian levels most of the personal ornaments were found in burials, while in the Late Natufian levels they have been recovered from the activity areas, at the fringes of the burial ground in the cave. Some of the Early Natufian burials in Hayonim Cave had been richly adorned, for example H.9 in Grave VII.

Grave VII – The Bone Pendants

Grave VII is a burial of a male (H.11) and young female (H.9) (pregnant? – there were remains of a fetus/new born among her bones; Belfer-Cohen 1988b) lying side by side with a young child at their feet. Fifty-two bone pendants arranged as a row of couples of pendants facing each other, were found around the pelvis of H.9, evidently part of a belt (Fig. 7.2). These bone pendants belong to the formal modus, namely they are a pre-planned, clear and coherent creation. They are made from long bones of gazelle, which was the main Natufian hunted animal (e.g. Munro 2001); each bone was split lengthwise and from each half several blanks were cut. Then, the tear-shape was created by a polishing technique (for detailed description of the production procedures, see Le Dosseur 2006:fig. 93). This specific shape follows an abstract convention, not constrained by the morphology of the raw material. Comparison with other jewelry types shows that the bone pendants are actually the extreme instance on the scale of “conventional” shape vs. the natural form of the raw material; thus, scaphopod shell beads were made simply by slicing the shell into thin or thick segments, their shape preserving most of the original features of the shell morphology. To create the fox teeth pendants, the Natufians perforated the tooth root and probably slightly polished the entire tooth surface to achieve a smooth, unified appearance, with the final form being a mere elaboration of the natural shape of the tooth. The same is true for the partridge tibio-tarsi beads – the bone was polished and the distal end was cut, and the final product is but a reduction of its original raw material.

The “tear-shaped” pendants have a clear geometric form, delicately modified and polished to perfection. Thus, its aesthetic features of symmetry, simplicity and sheen are perceptually attractive.¹ Clearly, they also portray a high

1 The articulation of specific morphological (aesthetic) qualities with perceptual mechanisms is well demonstrated; for example, the cognitive preference of vertical symmetry (e.g. Arnheim 1969) or the visual attractiveness of sheen (e.g. references in Saunders 2003:17).

level of standardization manifested by repeated production of many, almost identical, items. Moreover, this standard manufacture is not restricted to the Natufians of Hayonim Cave, as identical items were retrieved from other Natufian base camps, e.g. Kebara Cave, el-Wad and Eynan (Garrod and Bate 1937; Turville-Petre 1932; Valla et al. 1998).

Besides their inherent visual qualities, the context of these bone pendants (in Grave VII) illuminates another aspect. Since they comprised a “chain” around the hips, the probable friction of the pendants had an acoustic value. As such, the pendants could have represented an audio-visual object (i.e. an object which has visual qualities as well as acoustic qualities). It is of interest to note that other decorated burials from the site show various levels of sound feasibility (in each case, according to the jewelry type, composition and number of specimens). Some jewelry did not produce any sound, as for example when only a few beads are present, or when there is an admixture of pendants and scaphopod shell “spacers” (e.g. Grave III and Grave VI; Belfer-Cohen 1988b). Friction of small and light beads produced most probably faint sounds (as in the case of Homo 17, decorated only with scaphopod shell beads; or Homo 25, decorated with partridge tibio-tarsal beads; Belfer-Cohen 1988b). Conversely, the tear-shaped pendant “chains” produced a distinct rattling sound, raising the issue of archaeomusicology.

Archaeomusicology

The exploration of archaeomusicology begins with the identification of acoustic instruments within their archaeological context (Buckley 1998; Lund 1998). One method of identification is an examination through a set of evaluative criteria developed by d’Errico and Lawson (2006), among them: (1) feasibility, (2) ethnographical parallels, (3) ancient documentary support (text or image), (4) contemporary archeological support, and (5) efficiency (for details, see d’Errico and Lawson 2006). Following the identification of “acoustic instruments,” the organological classification – the Sachs and Hornbostel (S/H) scheme (Hornbostel and Sachs 1961) – provides a useful way to evaluate and formalize the means of producing sounds and their cultural perception. It is an abstraction of the cultural and musical dimensions inherent in different tools, when the classification is based on those features that can be identified from the visible form of the instrument itself. Musical instruments are defined as artifacts that organize the vibration that produces sound, and they are divided into four main groups (“families”):² (1) idiophones,

(2) membranophones, (3) chordophones, and (4) aerophones (Hornbostel and Sachs 1961). Associated issues are the morpho-technical structure, production techniques and performance. Additionally, archaeomusicology deals with the wider implications of the musical activity: its social role, meaning, cultural symbolism and even the emotional aspects and mental processes implied (Buckley 1998; Lund 1998).

The Musical Dimension of the Bone Pendants

The bone pendants in Grave VII were found in pairs, indicating their original castanets-like arrangement, which enhances the acoustic effect during dancing movements. Their identical size and plano-convex section suggest they were ideal for striking against each other. Their form seems particularly suitable for such clapping sounds since their lower parts are somewhat thicker and thus quite resonant.

Organological classification (Hornbostel and Sachs 1961) defines this pendant-belt as a strung rattle, a shaken idiophone – an instrument made of several hard objects that are strung on cords or tied in a bunch. Ethnomusicological examinations suggest it is among the earliest instruments known (Baines 1992; Sachs 1940; Sadie 1984); its purpose was to accentuate dancing. Suspended from the dancer’s body the strung-rattles respond to the dance movements with a sharp noise and accurate rhythm (Sachs 1940:25–26). Though restricted by shape, its highly flexible performance (by single/group dancers; in various arrangements: as bracelets, “belts,” anklets) can be culturally, or sub-culturally, coded.

Rhythmical music is based on tempo, the most common and the most important factor among the musical cues for emotions (Gabrielsson and Lindström 2001; Hevner 1937; Holbrook and Anand 1990). Its strong association with dance (rhythmic motions that accompany and indeed produce rhythmical music) involves not just the auditory system but the somatosensory and motor systems as well. Rhythmically repeated motions are the strongest basis for cooperation, because they are predictable by others, and others can thereby anticipate and move in accord with their expectations. Moreover, findings of anthropologists and psychiatrists show how rhythmic behavioral activities induced by beats of music can lead to altered states of consciousness, through which mutual trust among members of societies is engendered (Freeman 2001).³

² Each group is further sub-divided by different principles according to the particular nature of the group concerned (Hornbostel and Sachs 1961).

³ Music has the power to induce and modulate different emotional states, and these states are accompanied by release of neurohormones in affected brains (Freeman 2001). But we can specify different types of arousal in response to different modes of music (Becker 2001). Rhythmical music induces emotional states that are associated with intracranial release of dopamine and endorphins (Freeman 2001).



Figure 7.1 Tear-shaped bone pendants, Hayonim Cave (photos by D. Shaham).

Articulation of Aesthetic (Visual) and Musical Qualities

Both visual art and music are socio-cultural phenomena; both are, among others, an expressive means of communication. But while visual art is oriented toward communication of feelings, information, meanings and conventions, creating physical representations by visual manipulations (e.g. Berlyne 1971; Gombrich 1961; Feldman 1987), music is a specialized medium for communication of emotions by sound manipulations, generating temporal regularity (e.g. Cross and Woodruff 2009; McDermott and Hauser 2005). Music is often understood as communicating only emotions, having a limited information capacity, ultimately leaving it to the listeners to specify its precise “meaning” (Fitch 2006;

Juslin 2001). By acoustical cues to arouse emotions, it has the power to induce and modulate different emotional states (Freeman 2001), or even to be a catalyst for changing states of consciousness (Becker 2001).

In spite of this distinct nature of each art form, the strung rattle comprised of bone pendants is an audio-visual object that integrates acoustic and visual traits, an articulation based upon a shared feature that may be termed “communality.” Its visual attributes (e.g. a shape directed by a convention and inherent formal qualities like symmetry and sheen), in addition to the tempo-based rhythmical music, and the nature of the dance-constrained performance, altogether reflect “commonality” in perception and participation.

The intertwined and complementary musical and visual traits indicate shared roles in social interactions and communication; thus the audio-visual object was most probably an active device of ritualized behavior.

“Ritualization” is an ethological term (e.g. Huxley 1966), that defines the process in which components of a mundane behavior that is part of everyday activity, are taken out of context, “ritualized,” and used to signal an entirely different motivation, which may then influence the behavior of another party. Compared to the original mundane behavior, ritualized movements become “extraordinary;” the resulting signal attracts attention, and becomes prominent and distinctive.

Human ceremony, with its associated and necessary arts, has obvious parallels with the biological display of ritualized signals (although the former were culturally created, in contrast to the ritualized behaviors of animals, which are instinctive). The ceremonial displays establish a formalized framework of interaction that participants recognize as such; they literally embody in communal participation the mutual coordination they presuppose (Dissanayake 2006). While other aspects of the Natufian art (e.g. scaphopod shell decorations, incised slabs, etc.) may have had a role in ceremonies, the audio-visual objects present the strongest evidence of ritualization. Once visual representational, informative and expressive qualities integrate with musical regularity of time and instrumental emotional alteration, they create and establish artificial realities of knowledge, space and time. Thus, one might ask which behaviors and their social contexts might be the substrate for cultural recombination and elaboration. Bearing in mind the limits of the archaeological record of past behaviors, the materials at hand and their socio-cultural contexts might illustrate the substrate of the Natufian ritualization.

Gazelle was the most heavily exploited species by the Natufians (e.g. Munro 2001); its hunting was a common practice, and there is evidence for regular exploitation patterns (e.g. Bar-Oz et al. 2004; Campana and Crabtree 1990).

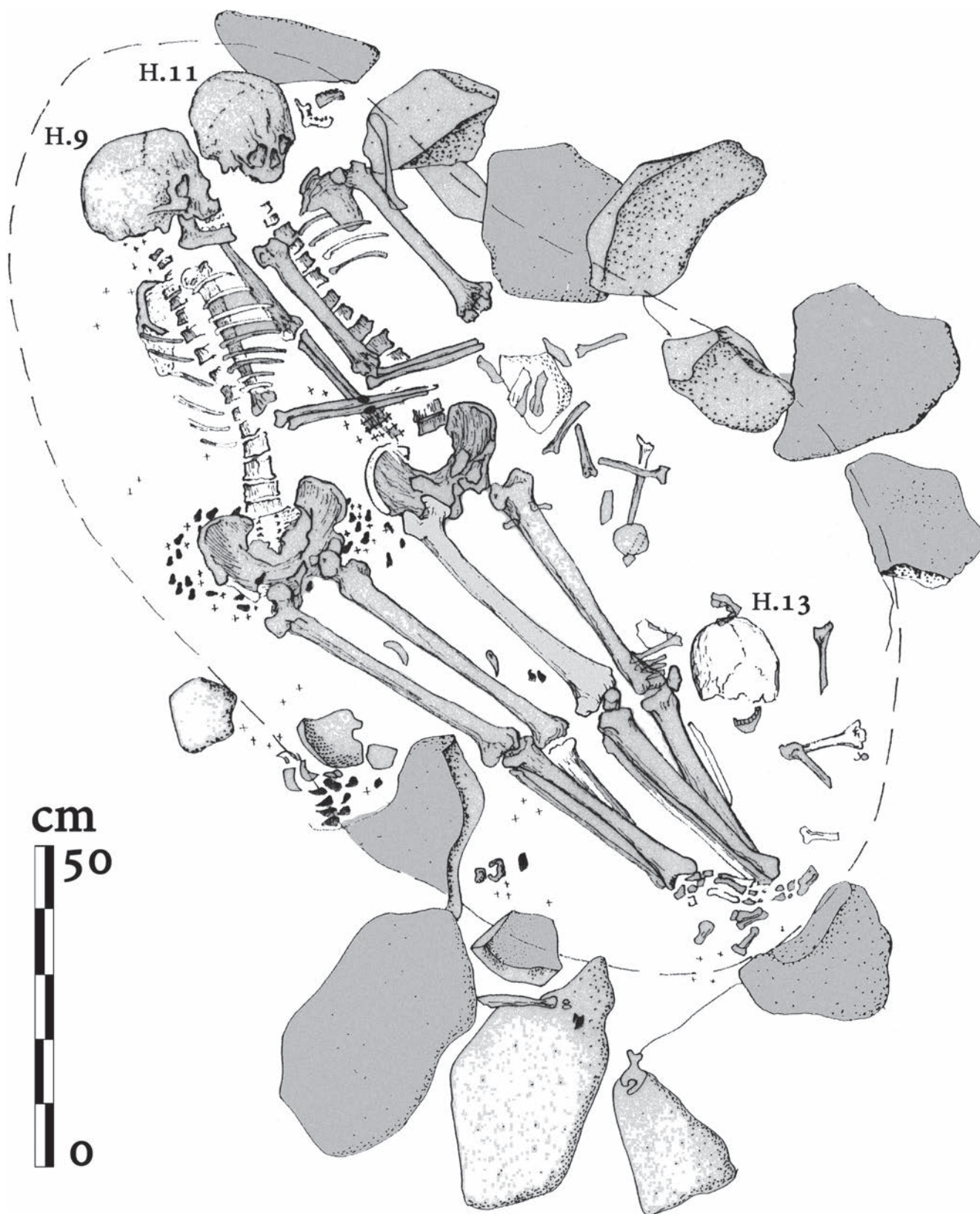


Figure 7.2 Plan of Grave VII in Hayonim Cave (after Belfer-Cohen 1988c).

Accordingly, the strung rattles reflect a triple articulation: audio-visual attributes portraying a common and characteristic cultural trait, which is connected to basic subsistence strategy as the raw material modified is gazelle bone. Large-scale cohesion and participation characterize both: the mundane behavior and the ritualized new device that became a new cultural habit in itself.

Conclusions

Clearly, personal ornaments have inherent artistic qualities that can be defined and characterized through comparative analysis integrating approaches derived from other disciplines, bodies of art objects and contextual information. Thus, in the present study, the bone pendants adorning H.9 can be identified as audio-visual objects, strung-rattle, the acoustic nature of which is of rhythmical music produced by body movements, which by definition is audio-motor. Altogether, such “instruments” were presumably employed in a communal social activity, portraying inter-social visual conventions and audio-motor rhythmical participation.

The process of ritualization in humane culture involved manipulations of material components by artistic means. Thus, artifacts that portray ritualization also reflect the particular behavior that was ritualized. At this point the newly created devices became a new cultural habit by themselves – they establish a formalized framework of interaction that participants recognize as such.

It seems to us that the bone pendants that were recovered from around the pelvis of H.9, Grave VII, at Hayonim Cave were “not just for show,” but possibly an active device of social cohesion. Moreover, the nature of these artifacts and their potential use shed light on aspects of certain social mechanisms. Probably these were employed as maintenance devices for the growing social complexity that accompanied the transformation from Paleolithic to Neolithic life ways.

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Bead Biographies from Neolithic Burial Contexts: Contributions from the Microscope

Annelou van Gijn

Abstract: Numerous beads and pendants of amber, jet and bone have been found in Dutch Middle and Late Neolithic funerary contexts. From 3750–2000 cal BC substantial changes took place in funerary practices. This paper addresses the role these ornaments played in the consecutive burial practices and what they tell us about the identity of the dead. Microscopic analysis provided evidence for repair, method of fastening and extent of wear, revealing the variety in bead biographies. In the Middle Neolithic, the dead were accompanied by their personal ornaments. In the subsequent Funnelbeaker period, during which the collective identity was a central concern, the beads were transformed from personal items to collective ones, by re-grinding and hence depersonalizing them. A parallel is found in the axes, also a personal item, which were subjected to the same transformation prior to their deposition in the grave. During the Beaker period, beads from different mourners were assembled, each with their own biography, in order to unite the community in the burial ceremony.

Beads and People

Ornaments trigger people's imagination. They are closely connected to individual human beings, telling us about the way they adorned themselves and about their identity. They are also “pretty little things,” pleasing our senses because they are colorful, shiny and often made of precious materials. They may come from afar, symbolizing places and people beyond the sphere of regular interaction. Ornaments embody memories of those who owned them. Often it concerns heirlooms that connect the ancestors and the living. However, in archaeology ornaments have until recently received relatively little attention (but see Newell et al. 1990). Nowadays, with the ever-increasing interest in the materiality of things, studies of ornaments are rapidly becoming one of the foci of material culture studies (e.g. Bar-Yosef and Porat 2008; Bonnardin 2008; Cristiani and Borić 2012; Lenneis 2007; Vanhaeren and d’Errico 2006; Woodward 2002).

In recent years, several large-scale rescue excavations in the Netherlands have produced a great number of beads and pendants made of amber, jet and bone, all

of which were subjected to microwear analysis. These initial contract studies led the present author to start a larger research project to examine changes in bead production and use through the Neolithic and Bronze Age, including both domestic and funerary contexts. The objective was to examine the biographies of the beads, studying traces of manufacturing and use, context of deposition and the association with other categories of material culture. The study relied on experimentation and microwear analysis. Use was made of a Wild M3z and a Leica M80 stereomicroscope with magnifications of up to 160×. If the ornament was sufficiently well preserved, a metallographic (incident light) microscope was also used (Nikon Optiphot), allowing much higher magnifications (100–300×) and providing details of the kind of polishing and micro-striations.

This paper focuses on the role of amber, jet and bone beads in the materiality of burial practices in the Dutch Middle and Late Neolithic between 3750 and 2000 cal BC. The Middle Neolithic B is represented by the Hazendonk culture (Louwe Kooijmans 2005), distributed

for the most part in the wetlands of the western part of the present-day Netherlands (Fig. 8.1). The Hazendonk culture shares some features with the Michelsberg culture further inland, having similar pottery and imports of typical Michelsberg flint items. Ornaments have been encountered in the excavated settlements like Schipluiden, but only in very limited numbers (Van Gijn 2006). Most ornaments came from the cemetery of Ypenburg (Van Gijn 2008). The Late Neolithic A Funnelbeaker culture (3400–2900 cal BC), is best known for the *hunebedden*, megaliths that served as collective burial tombs (Van Gijn and Bakker 2005). Funnelbeaker sites are known from the Pleistocene uplands in the central and northeastern parts of the present-day Netherlands such as Drenthe and the Veluwe. Amber beads as well as the occasional jet ornament were deposited in these megaliths. The

Funnelbeaker culture is followed by the Single Grave culture, dating to 2900–2500 cal BC. During this period, the burial practice changed from the communal graves of the megaliths to individual barrows (Fokkens 2005). Although extensive amber bead production is attested in the Single Grave settlements on the Dutch coast, as at Zeewijk (Van Gijn 2014), Aartswoud (Piena and Drenth 2001) and Mienakker (Bulten 2001), amber beads are a very rare occurrence in Single Grave barrows. In the subsequent Bell Beaker period (2500–2000 cal BC), several barrows have produced amber beads, as shown by two recently excavated graves at Hattemerbroek, near Zwolle, where dozens of amber beads were revealed (Drenth, et al. 2011) (Fig. 8.1).

The technological and microwear study of these beads shows that their biographies changed over time. Not only



Figure 8.1 Map depicting the location of the various sites and regions mentioned in the text (drawing by Walter Laan, Archol, Leiden).

does their morphology change but, more importantly, the way they were used and treated before and upon deposition varies between the different periods. This suggests that these beads may have played an active role in the burial practices at the time. Between 3750–2000 cal BC substantial changes took place in the burial practices. In the Middle Neolithic Hazendonk culture the dead were buried in individual graves in a cemetery. Two graves contained more than one individual: one with two children and one with one adult, a child and a baby (Baetsen 2008). In most graves the dead are buried on one side with their knees drawn up. The Funnelbeaker people buried their dead in the megaliths, which constitute collective burial places. Some of the deceased were, however, buried in individual graves, in flat graves or stone cists, but it is unclear what determined the kind of burial chosen, as the burial goods in the three contexts are similar (Van Gijn and Bakker 2005). Individual graves start to predominate during the Beaker period with the construction of burial mounds (Fokkens 1998).

This paper addresses the questions, what role did the ornaments play in these changing burial practices and what do they tell us about the identity of the dead? Do the changes observed in bead biographies over time correspond with other information on burial practices from these periods?

The Personal Ornaments from the Middle Neolithic Hazendonk Culture

A number of sites attributed to the Middle Neolithic Hazendonk culture were excavated between 1990 and 2010 near the present-day town of The Hague. A considerable number of finds of amber and jet were brought to light, including finished beads and pendants (Figures 8.2 and 8.3) as well as fragments of the raw materials used to make them. The presence of production waste, half-finished beads and also of flint tools with use wear traces from cutting jet and piercing amber within the settlement area of Ypenburg, indicates that bead production took place locally (Van Gijn 2008:fig. 14.6). This is also the case for the nearby settlement site of Schipluiden where toolkits could be reconstructed for amber and jet bead production (Van Gijn 2006). The raw material was most likely procured on the nearby beaches. Jet must have been present in quite abundant amounts, considering the large number of nodules and blanks found at Schipluiden. Amber is probably of Baltic origin. Finished, heavily worn ornaments are absent at Schipluiden, with broken and unfinished beads predominating. One tubular, heavily worn bead was probably lost (Figure 8.3b). However, worn but usable beads are unlikely to occur in settlement contexts as they are taken along when people left the settlement,

being attached to individuals who do not part with these personal items when leaving a place (Van Gijn 2014).

Excavation of the large cemetery of Ypenburg revealed 31 graves with at least 38 individuals – men, women and children (Baetsen 2008). Several of the graves of women and children had amber, jet and bone beads, whereas with one exception those of the men did not contain any ornaments at all. In total, 43 artifacts of jet and amber were found, along with one bone ring (Fig. 8.2). The beads associated with the women's graves are all heavily worn, indicating they were most likely personal ornaments that were used as jewelry during the life of the deceased. The jet beads were extremely rounded, displaying an intense shine, very much contrasting with the dull beads found at the contemporaneous settlement of Schipluiden (Fig. 8.3a vs. 8.3b). The shine on the Ypenburg funerary beads is most likely due to repeated contact with skin, indicating their long time use as personal ornaments. Their placement near the ears and head (Baetsen 2008) suggests they were part of some sort of headdress. In fact, wear traces were seen where the fastening caused a more extensive polish.

Children's ornaments at Ypenburg generally do not display any evidence for wear and tear (Fig. 8.4a, b). Their ornaments look remarkably fresh, suggesting they were made specifically for them. Production traces including the marks of the borer and the striations and linear polish from grinding the bead were still clearly visible on one of the amber beads from a child's grave (Fig. 8.4a, b). Similarly, the bone ring (Fig. 8.2, right-hand corner) also displayed fresh production traces. This also appears to be the case with the two bone beads made from the ulna of a swan, which accompanied a child's burial within the settlement area of Schipluiden (Fig. 8.4c) (Van Gijn 2006). These two beads bear no traces of having been worn, whereas the manufacturing traces look very fresh. It seems therefore that new ornaments were made for children, ornaments that were hardly worn at the time of their death. One interesting exception is a heavily worn, very shiny amber bead that must have been used for a long time, but nevertheless is associated with a child's burial. It displayed a secondary perforation that was completely fresh. This bead is interpreted as a reworked bead, possibly an heirloom that was "rejuvenated" by creating this new perforation. As an heirloom, it represented the personal relationship between the original owner and bearer of the ornament and the child to which it was subsequently given. This material connection between a young child and a member of a previous generation suggests that children were already very much part of society even at a young age. The fact that children received ornaments, a personal item *par excellence*, also implies that they were regarded as members of the community.

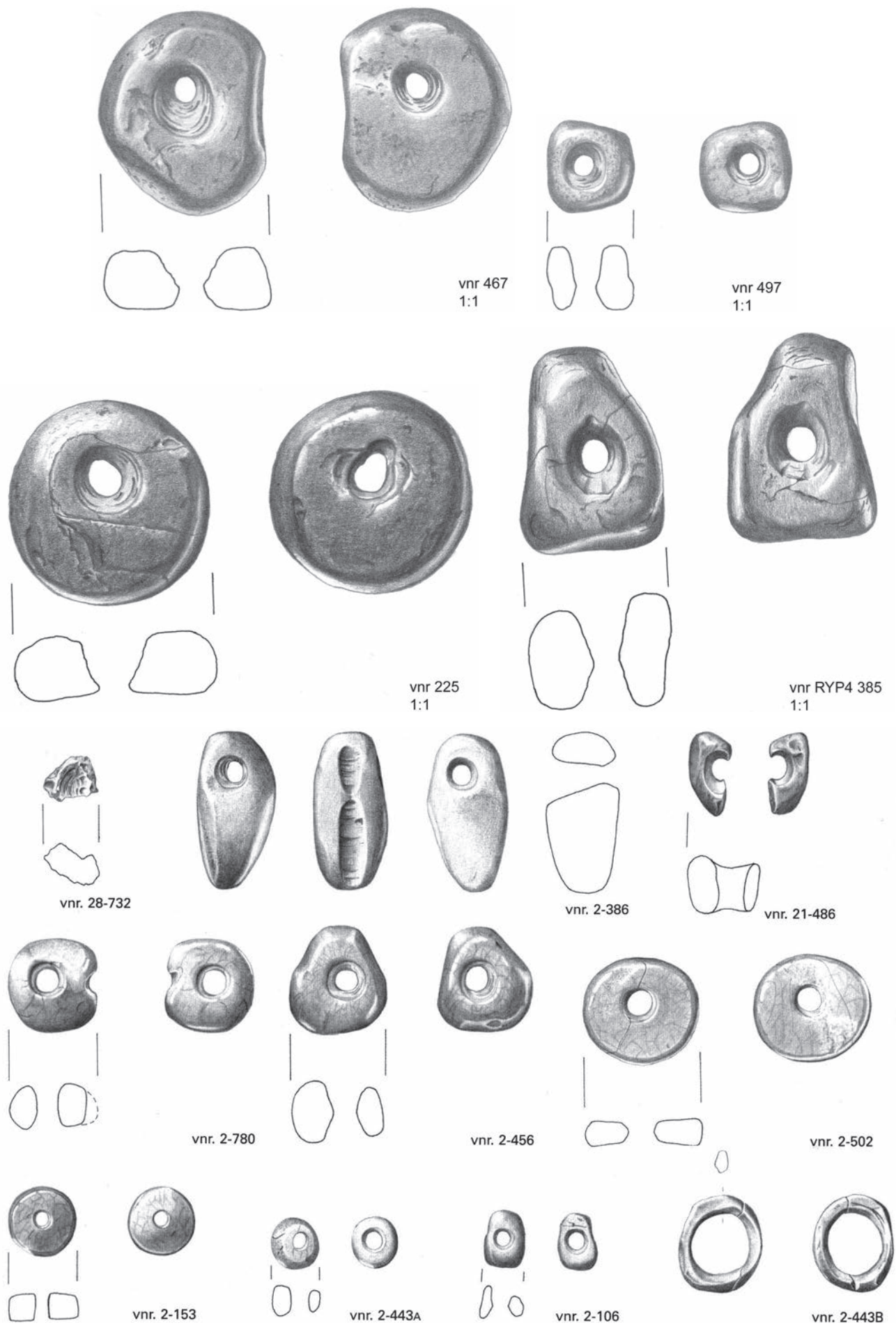


Figure 8.2 Amber, jet and bone ornaments from Ypenburg (drawing by Raf Timmermans; from Van Gijn 2008) (scale 1:1).



Figure 8.3 Selection of beads from a. Ypenburg and b. Schipluiden, showing the intense luster from use on most of the beads from Ypenburg and the lack thereof on the Schipluiden ornaments (photos by Ben Grishaver, Leiden; from Van Gijn 2006 and 2008).

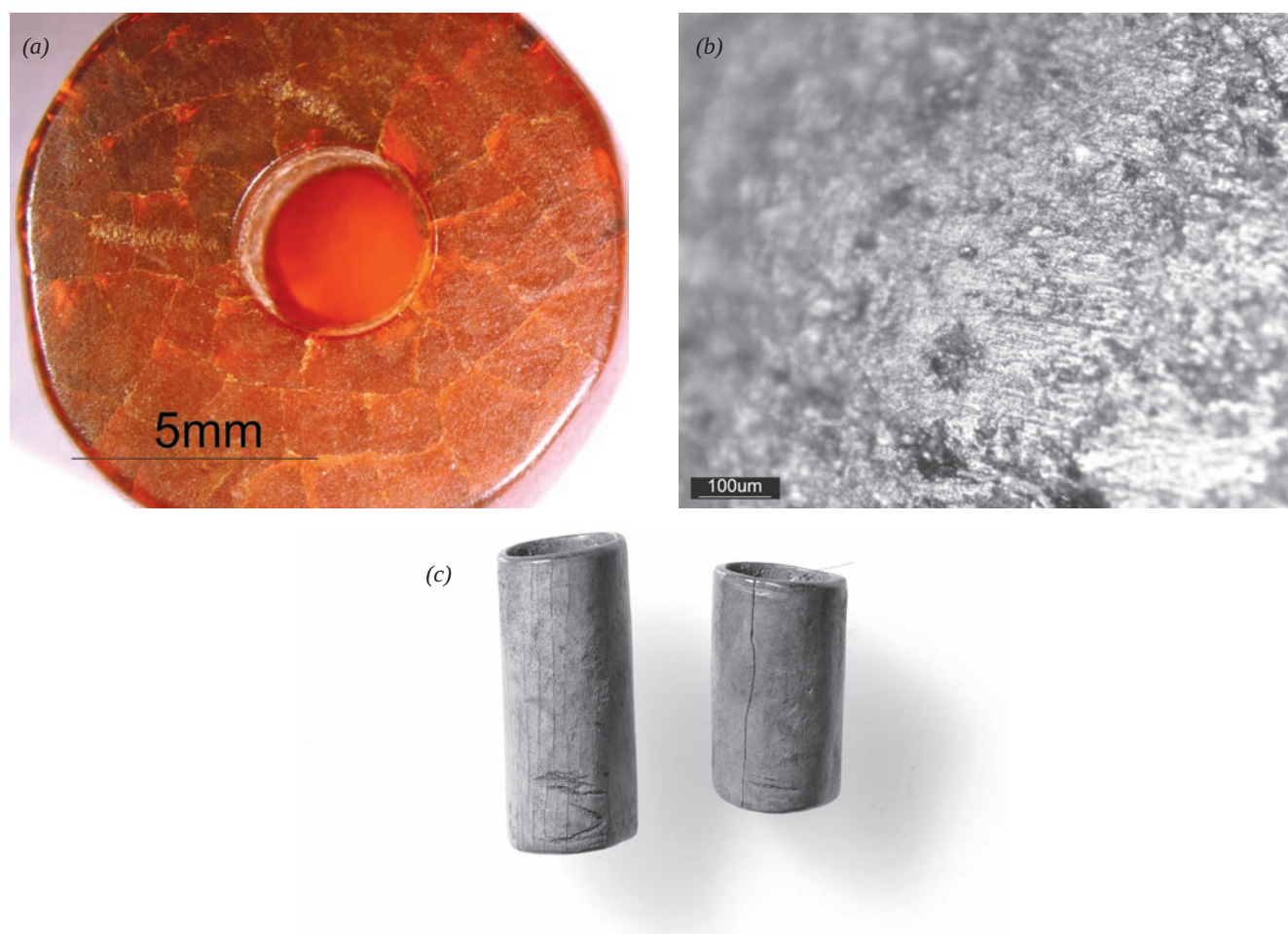


Figure 8.4 a. from Ypenburg cemetery (find nr. 2-153), displaying the slippage marks of the borer on the surface; b. fresh grinding marks on the same bead; c. bone beads from a child's grave in Schipluiden, made from a swan ulna (photo by Ben Grishaver, Leiden; from Van Gijn 2006).

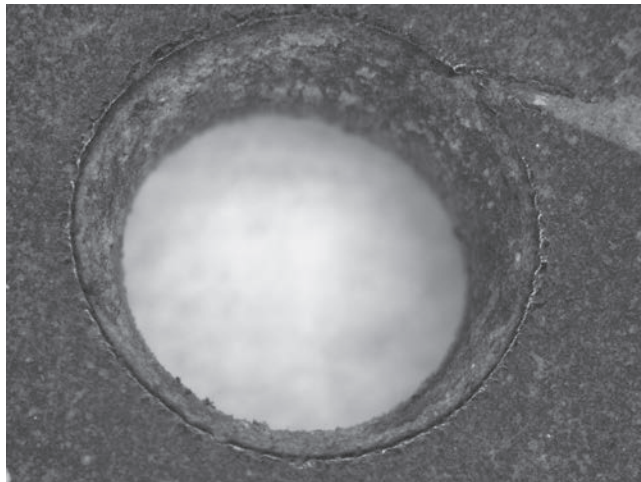


Figure 8.5 Ground bead from a Funnelbeaker megalith displaying the freshly ground intersection of the top surface with the worn perforation (from Verschoof 2011).

Beads and Axes from the Funnelbeaker Culture: Stressing the Collective Identity

From 3400–2900 cal BC people of the Funnelbeaker culture inhabited much of the central and northeastern parts of the Pleistocene uplands. From 3400–3200 cal BC megaliths were constructed, mostly in the province of Drenthe where building material was available (Bakker 2005). These monuments are interpreted as communal burial places. Most human remains have not preserved due to the low pH of the soil, but they contain cremation remains, lots of pottery, flint and other stone objects. Virtually all of the Dutch megaliths were quite rapidly excavated in the 1930s and often poorly documented. Thus, unfortunately, we have no spatial information about the finds. Although the pottery has been extensively studied, the stone material, and hence also the beads, were never studied in detail.

Most of the beads are flat and disc-shaped with a biconical perforation. Unfortunately, many of the beads are in a rather poor state due to oxidation making an examination with a metallographic microscope fruitless (Verschoof 2011). Nevertheless, in many cases, the wear could be inferred from the smoothness of the circumference of the bead and the smoothing of the circular rings on the inside of the perforation by the string. Surprisingly, however, the two flat surfaces of these discoid beads seem to have been ground down prior to deposition, as evidenced by the sharp transition between the perforation and the surface of the bead (Verschoof 2011) (Fig. 8.5). This sharp transition is not in congruence with the regular fading out of the perforation that would be expected on a worn bead.

Remarkably, this peculiar regrinding of the beads has a parallel in the flint assemblage from these megaliths. One of the most conspicuous, albeit rather rare, flint tool types in the megaliths are the axes (Brindley 1986). These

axes are heavily worn and frequently re-sharpened and, in consequence, they are quite small (Van Gijn 2010; Wentink 2006) (Fig. 8.6a, b). Why re-sharpen exactly these two types of artifacts, beads and axes? It can be argued that both were personal objects that were owned by and very much associated with a specific individual. As said above, ornaments are regarded as personal items, intimately connected to the identity of their owner because they were worn during the life of the person. But why should axes be considered such a very personal item, connected with individual human beings? Although most archaeologists would regard an axe as simply a tool, anyone who has ever yielded an axe purposively, knows that it is very much a personal object. Not only does every axe not suit a particular person, but the movement and the way of holding the axe is very much a result of the interplay between the musculature and physique of the user, and the morphological specifics of the axe. In fact, when using the axe in a skillful and confident manner, obtained through long time use and habituation, the axe becomes an extension of the body, with the boundary between hand and tool disappearing.

The fact that both axes and beads were intimately connected with the personal identity of specific individuals makes them inappropriate to be included in a communal burial tomb such as the megaliths. However, that may be precisely the reason that both beads and axes were reground: to remove any association with their individual user or owner. This makes both beads and axes very much part of the materiality of Funnelbeaker burial ritual, which seems to be a communal affair just like other community activities such as agriculture (Van Gijn 2013). Both types of objects had to be de-personalized before they could be included in the communal burial tomb.

Beaker Beads: Assembling the Mourners

The last period, the Beaker period, dating ca. 2900–2000 cal BC is a time during which the burial ritual changes quite substantially. Instead of the communal burial tombs of the preceding Funnelbeaker culture, the dead are buried in barrows (Fokkens 1998). These are mainly situated in the Pleistocene uplands of the central and northeastern part of the country (Bourgeois 2013). Beads are a rare occurrence in the earlier Single Grave Beaker period, dating to 2900–2500 cal BC (Lanting and Van der Waals 1976). One notable exception is the barrow of Garderen where 39 amber beads were found (Fig. 8.7a). Notably, many of these beads are hardly or only roughly modified, including a number of perforated amber nodules. Microwear analysis of the beads by the author shows that their individual biographies are variable: some beads were heavily used; others show hardly any signs of wear; some display evidence of re-use and repair (Fig. 8.7b).

These beads differ greatly in terms of production, morphology and use from beads known from



Figure 8.6 a. Worn axes from megalith D19 (photo by Q. Bourgeois, Leiden); b. re-sharpening traces on axe (photo by Laboratory for Artefact Studies, Leiden; from Wentink 2006).

contemporaneous settlement sites. In the Single Grave settlement sites on the west coast, there is evidence for considerable amber bead production as inferred from the presence of blanks, waste flakes and half-finished beads at Zeewijk (Van Gijn 2014), Aartswoud (Piena and Drenth 2001), Mienakker (Bulten 2001) and Kolhorn (observations

by O. Passeniers and the author). The finished beads from these sites are small, discoid-shaped and finely worked, being different in every respect from the funerary beads such as those coming from the Garderen burial.

Whereas amber beads are rare in Single Grave funerary contexts, subsequent Bell Beaker graves frequently



Figure 8.7 a. Funerary gifts from a Single Grave barrow at Garderen on the Veluwe (photo by Rijksmuseum voor Oudheden, Leiden); b. close-up of one of the amber beads from this grave, showing multiple (attempts) at perforations (photo by Laboratory for Artefact Studies, Leiden).

contain such objects (Drenth et al. 2011). Recently two Bell Beaker graves were found near the modern town of Zwolle in the north. Grave 1 from the site Hanzelijn contained 16 amber beads of different types (Fig. 8.8a). With the exception of the small discoid-shaped beads, most ornaments were situated around the head of the deceased. Many of these decorative items seem to have been sewn onto a piece of cloth and not strung in sequence to make a necklace. This could be inferred from the extensive wear on the inside of these beads, the thread cutting through most of the surface (Fig. 8.8b). The beads display very different degrees of wear. This may point to repair activities on the headband but there is no functional reason to assume that the different beads would wear differentially. An alternative explanation for the different bead biographies is that the beads were assembled for the burial ceremony, thereby uniting different mourners. The act of assembling different beads, each with a different history and associations with different persons, could have brought these people together and strengthened their ties in mourning.

Grave 2 from the nearby Bell Beaker site Hattermerbroek-Bedrijventerrein Zuid produced 18 V-shaped amber buttons. They were found near the head of the deceased. The location of the wear traces on the outer rim of the perforation and on the top of the bridge indicates that the buttons were fastened on a piece of cloth in sequence (Fig. 8.9a). The beads displayed very different wear patterns. Some are extremely worn, others hardly display traces of wear with extremely fresh looking perforations (Fig. 8.9b vs. 8.9c). The bead depicted in Figure 8.9b appears to be relatively newly made. The most heavily worn piece is a button on which the bridge between the two parts of the perforation is completely worn through. However, they did not discard this broken bead, but

“revived” it by placing a new V-shaped perforation at a 180-degree angle to the old one (Fig. 8.9c). If the reconstruction of the application of these 18 buttons is correct and they were indeed sewn onto a headdress, then there is no functional reason why their biographies should vary so much. That is, such a fastening would not result in differentially worn buttons. Instead, these varying biographies suggest that the buttons may have been brought together and sewn onto the headband for the specific occasion of the burial of the deceased. Assembling beads with different biographies was postulated above for Hanzelijn Grave 1. It seems that uniting people’s personal ornaments into a collective item, a headdress adorned with the personal beads from different mourners, was important to the Bell Beaker people. It formed a material reflection of the ties between different people, coming together in the burial occasion.

Conclusion

Microscopic examination of the wear patterns of beads and pendants from funerary contexts has revealed how the beads were made, worn, repaired and transformed upon discard. This biographical information on the funerary beads, dating to consecutive periods of the Dutch Neolithic, has shown their changing role in the material representation of the burial ritual. In the earliest, Middle Neolithic Hazendonk period, personal ornaments were presented for the burial rite in the state in which they were at the time of the death of their owner. Most of the beads and pendants are very heavily worn, being totally smoothed and with heavily rounded perforations, indicating they had a long use life and were closely connected with the person with whom they were buried. With the exception of one man with an amber bead, only women and children were accompanied

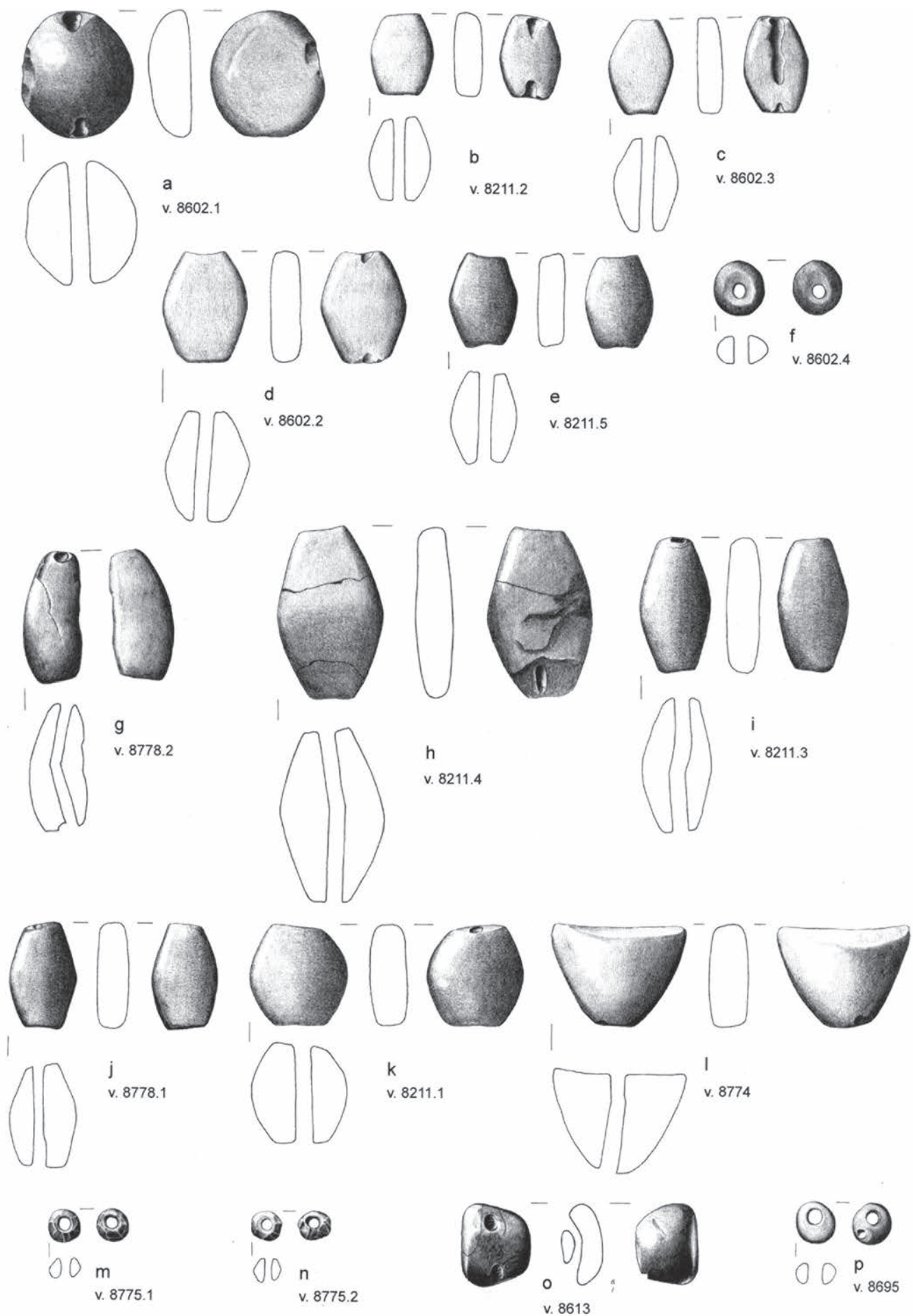


Figure 8.8 a. Amber beads from the Bell Beaker Grave 1 of the Hanzelijn site (drawing by Raf Timmermans; from Drenth et al. 2011) (scale 1:1).

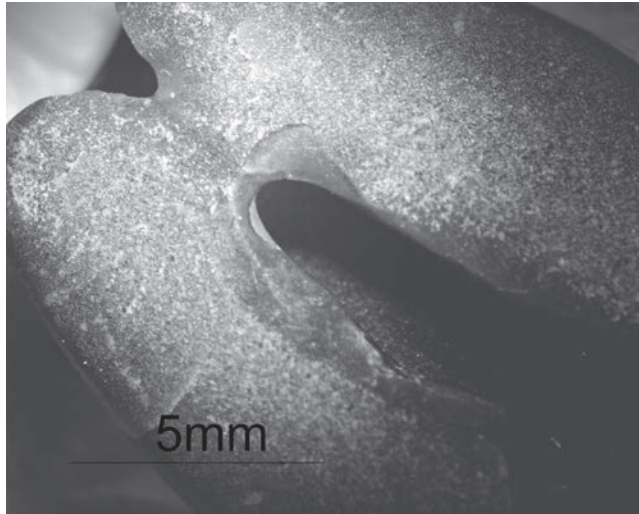


Figure 8.8 b. close up of the worn perforation of one of the flat lozenge-shaped beads indicating it was sewn onto a piece of cloth (photo by Laboratory for Artefact Studies, Leiden; from Drenth et al. 2011).

by ornaments. One heavily worn bead with a very fresh looking perforation, given to a child, was interpreted as an heirloom. The presence of an heirloom in a child's grave indicates that children were regarded as integral members of the community even at an early age.

The ornaments from the subsequent Funnelbeaker time have well developed wear traces within the perforations indicating that these ornaments had a long use life, probably as personal ornaments of individual members of the community. However, the flat surface of the discoid beads is freshly ground, eliminating the wear of the perforation at the intersection of bead face and perforation. It seems as if the association of the bead with a particular individual had to be obliterated before the bead was suitable for deposition in the collective burial tomb of the megalith. A parallel exists in the axes, very much a personal item as well, which were subjected to the same transformation: the edges were re-sharpened prior to the deposition of the axes in the megalith. We should see these transformations of personal items in the light of what we know of the Funnelbeaker culture, a period during which the collective identity was a central concern. The beads – and the axes – had to be transformed from personal items to collective ones, by re-grinding and hence depersonalizing them.

In the following Beaker period the role of beads in funerary contexts changed once again: beads within the same grave display a variety of biographies, as expressed by differing degrees of wear. The wear traces on the beads from the two Bell Beaker burials near Hattermerbroek indicate that they formed part of some sort of headdress onto which they were sewn. Some beads were extremely worn which could

hardly have resulted from differential wear. An alternative explanation could be that these beads were brought together by different mourners, each bead being closely associated as personal ornament with a specific individual. In bringing together all these personal ornaments with their different biographies into one collective item for the person buried, the communal ties could be strengthened. There is growing evidence that the Beaker graves did not so much constitute graves of high rank individuals, but of people representing their community (K. Wentink, pers. comm. 2015). The second explanation would be quite consistent with this view of Bell Beaker funeral practices.

In conclusion, it is argued that a detailed microscopic examination of personal ornaments can shed light on the materiality of burial practices. The information obtained through a thorough study of materials far exceeds a simple enumeration of the number and type of beads present in a burial. The ornaments tell a story that, on the one hand, fits very well with other sources of information on burial practices in the respective periods, and brings these ceremonies to life by adding important details on actual practices and choices.

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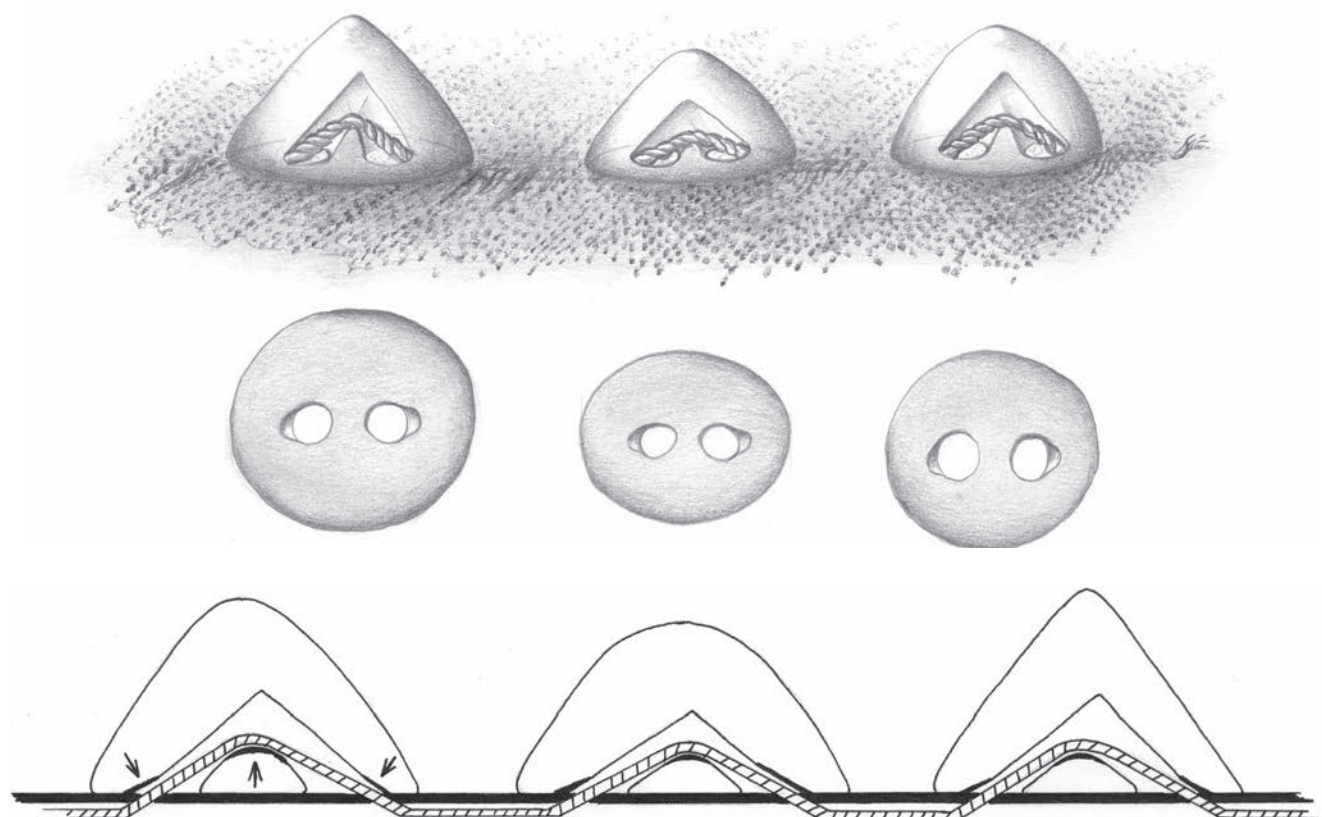


Figure 8.9 a. Reconstruction of the way the V-shaped buttons were attached to a piece of clothing. Arrows indicate the locations where the buttons were worn most extensively (drawings by Raf Timmermans).

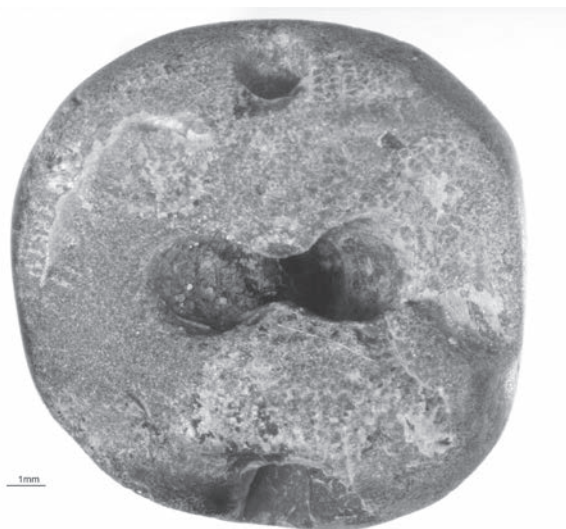
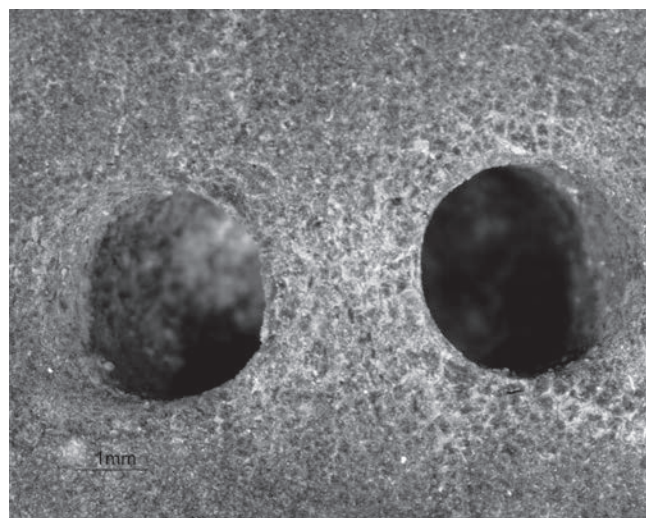


Figure 8.9 b. photo of a fresh, hardly worn perforation; c. a heavily worn button displaying a broken perforation and a newly made one at a 180-degree angle (photo by Laboratory for Artefact Studies, Leiden)

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The Tutankhamun Beadwork: An Introduction to Archaeological Beadwork Analysis

Jolanda E. M. F. Bos

Abstract: *In the early 1920s, when the archaeologist Howard Carter excavated the tomb of Tutankhamun (a pharaoh reigning in the fourteenth century BC, the Egyptian 18th Dynasty), a large number of beaded items were uncovered. Most of the objects still contained the thread on which they were strung 2,500 years before. Because the fiber was decaying, the items could not be lifted without destroying the composition. Carter therefore lifted the beadwork from the context of the tomb by pouring liquid wax onto the objects. Even though this technique is irreversible and would not be preferred today, it did preserve both beads and string in their original composition, giving archaeologists today the unique opportunity to study this beadwork. The diversity of the beaded items makes the Tutankhamun beadwork exceptional. Some years ago, Jolanda Bos began the study of these beaded objects and developed the initial outline of a system for documenting and analyzing archaeological beadwork in Egyptian contexts. In this article, the basics of this system and how it contributed to the research of the Tutankhamun beadwork, is described. Although the study of the Tutankhamun beadwork is not finished, some preliminary results will be presented here. A tunic found inside the tomb of Tutankhamun will be discussed as a case study. The analysis showed interesting social aspects of beadwork production as well as unexpected technological solutions. The case study of the Tutankhamun beadwork will show how beadwork analysis may shed light on production aspects such as how much time was spent on production and use.*

The History of Archaeological Beadwork Analysis

Individual beads represent an often-studied artifact group in the field of archaeology. They are found in very early contexts (Dubin 1987:18). Many times, their different shapes, colors and sizes have been described and categorized in order to study their spatial distribution or the origin of the various objects they decorate (Beck 1928; Gordon and Kahan 1976; Francis 1994; Jurriaans-Helle 1995; Sleen 1967). Beadwork analysis however – the technological study of beaded fabrics or artifacts – is little practiced in archaeology. Beadwork studies are more frequently found in the field of ethnography (Allen and Hector 2009; Wright 2001).

Beadwork may be defined here as an artifact, or part of an artifact made of beads, deliberately clustered together in a specific order by a binding material. This definition takes into account beadwork constructed with thread of various

materials. The definition also incorporates beads clustered together by being pressed into clay or beads held together by any other binding material. The definition emphasizes the two most important aspects of any beaded fabric: the binding (the materials and techniques used) and the pattern (the specific order in which the beads are placed). Although some work has been done by Johnson on beadwork in relation to ancient Egyptian crowns and headdresses (Johnson 1991, 1994) and by Bosse-Griffiths on Egyptian disk bead compositions (Bosse-Griffiths 1975), very little is said about the techniques by which the different objects were made in antiquity in Egyptian archaeological publications. This is partially due to the fact that the objects are often fragile and usually not well preserved in archaeological contexts. The different properties or characteristics of the materials from which the objects were made, contribute to this problem. The extremity of the combination of heavy and sharp beads

(often inorganic or more resistant) and the fragile (often fibrous or organic) string, makes for poor preservation conditions for the artifacts. Most of the time, the string, often twined with very thin yarns in order to fit the perforation of the bead, has deteriorated partially or even completely. However, the information potential of these poorly preserved objects can easily be underestimated. For instance, the location and orientation of the beads *in situ*, even when the string has completely vanished, can still provide clues about the techniques used in making the object.

What methods, then, may aid field archaeologists in recording and preserving beadwork? Methods used for lifting beadwork often depend on the situation at hand. Lifting is the true challenge of excavating beadwork. The stress on the thread is often difficult to minimize. One of the materials that may be used in the process of lifting beadwork is Cyclododecane (C₁₂H₂₄), a chemical substance used in conservation work among other things. Although the effects of this chemical have not been studied extensively, it is a reversible technique that allows beadwork to be lifted and transported. In this manner, the pattern as well as the binding may be preserved for future study. Lifting beadwork without chemical aid is still best done by hand, creating small supports or partially inserting new string or (metal) wire where necessary and possible. The beading technique however is ideally recorded before lifting the object, since it may be damaged or lost in the process.

Beadwork Analyses and its Uses

Introduction

In ancient Egypt, the majority of the beaded objects were found in tombs of kings or noblemen. From tombs or different contexts associated with the “ordinary person” more simple strings of beads were uncovered (Jurriaans-Helle 1995:56). Social stratification will not only be illustrated by the presence or absence of beads or beadwork in burials, but most often by the complexity of the techniques used. Using an object made of breakable glass beads and fragile beadwork that frequently needed repairs, may show the owner’s status or wealth and the ability to support these repairs and techniques. The string used in many of the Egyptian bead net dresses is often too fragile and the beads too heavy for the dresses to have been used intensively without frequent repairs (Bos 1994:3; Engelbach 1929; Hall 1981:40; Hall 1986:65). It has been suggested that these dresses could not have been used to sit in. The string of the objects might break under the pressure of a body and the sharp edges of the Egyptian faïence beads (Vogelsang-Eastwood 1994:80). To the modern observer this seems a dichotomy, although the suggestion can also be made that more tightly beaded tunics may only have been used in, for instance, processions or in funerary contexts. The presence of beaded sandals, as found inside the tomb of Tutankhamun

(catalogued by Carter as 085a), may be an indication of the ultimate display of this status. Walking on the fragile glass and threaded objects must have meant frequent repairs were necessary. It seems that using beaded sandals emphasized the wealth of the person who owns them.

In addition to the interpretation of the object itself, analyzing the fabrication and pattern of the ancient artifacts enables us to gain insight concerning the time spent on the production process, as well as the nature of the subsequent use. Some examples are presented below. Gender related issues concerning the production process remain unanswered for now, although in ancient Egyptian reliefs, only men are shown producing both beads and beadwork (Aldred 1971:19–23; Andrews 1990:67–79). Analyzing the way in which the string was cast off will give information on the rhythm of the production work. Aspects like coarseness of the fabric and tightness of the construction will show both the experience of the worker as well as the pace at which he or she was working.

A System for Beadwork Analysis

During the research on the Tutankhamun beadwork, a first attempt was made to outline a recording system for documenting and analyzing beadwork in the field (Fig. 9.1). This system, in this phase of the research, does not define how to register aspects of beadwork in the field; it merely lists what aspects of beadwork should be registered and shows what role they may play in the analysis or the interpretation of the beadwork. The scheme, as presented here, is roughly divided into three descriptive levels; a description of the object as a whole, the study of the techniques used in the production and a breakdown of the pattern in which the artifact was constructed. Each of these three levels may be subdivided into separate aspects. When the description of these levels is completed, the analysis of all described elements in the scheme will provide a picture of the function and use of a beaded artifact, sometimes reflecting decisions on production made in antiquity. During the analysis of the Tutankhamun beadwork, not only was this recording system used, but also photographs, schematic drawings and reconstructions were made. In beadwork research, reconstructions provide important insight into the understanding of beadwork techniques (Bos 2007:58). In future research this system will be developed further into a model for beadwork analysis.

First, on the “object level,” a description of the object as a whole is provided, including dimensions, the overall shape of the object, as well as the different materials used in the manufacturing process. Furthermore, documenting the apparent use and function of the object is of importance. Wear, tear and repair marks, as well as excavated context were useful in interpreting the function and use of the artifact as well as the intensity or rarity of its use. Of course, the

Object level	Kind	function/use	— archaeological context — additional information on discard — wear marks — tear marks — repairs y/n and where in the fabric
	Meaning	location of the find object symbolism	— archaeological context — (of the object as a whole)
	Style	date	
	Shape	object form, 3 dimensional object y/n	
	Dimensions	length width thickness	
	Materials	kind, combination of material groups?	
Construction level	Technique	technique in general	— stringing? How many elements in the fabric
		beginning	— knots/active or passive elements
		direction of the beading	— passing of the thread/binding; change of direction/function of binding
		active/passive elements	— beads and binding material
		tightness pulling in general	— thread or other binding material
		increasing/decreasing	— amounts — methods — locations
		affixation of new elements	— increasing — affixation new materials — separate beadwork structures, how connected, amount of phases in the work
		cast off	— knots — redirecting/finishing thread
		repairs	— methods/techniques of repair
	Kind of fabric	coarseness of the fabric	— amount of beads producing the pattern — flexibility of the fabric
	Materials	kind of binding material and the implications of its usage	— material and characteristics — dimensions — colors/effects
		Type of beads	— shapes — perforations — dimensions — colors
	Symbols' in the construction	functionality of repairs	
		deliberate mistakes	— irregularities
		attention/sloppiness	— irregularities in the work, tightness
Pattern level	Shaping	strain on the binding use of moulds construction of separately beaded elements	
	Order	use of colors shape of beads amount	
	Orientation of the pattern or symbols in relation to object level		

Figure 9.1 System for the description of beaded artifacts found in archaeological context as developed during the research on the Tutankhamun beadwork (illustration by Jolanda Bos).

symbolic pattern of the beads and its interpretation is an important indicator for interpreting the function as well as the meaning of the object.

Secondly, in order to describe the artifacts on the level of their construction, different constructive elements were noted. The materials used were documented in detail, including the properties (dimensions, material, color) and quality of the binding material, the consequences of its use, and the type of beads (dimensions, color and shape, and perforations). The latter was described using Beck's classification method (Beck 1928). Where the thread was not preserved, the size of the perforation of the bead as well as the weight of the bead became an indication for the size and kind of the string used. Coarse sides on the Egyptian faïence and glass beads will for example indicate that a strong binding material must have been used in the construction. These coarse edges will easily cut through string – not just while the object is in use but also while pulling the string through the beads during the production process. These elements provide some idea about the binding of the artifact even when it is not preserved. Furthermore, the most important elements of the construction to be determined were: the beginning of the technique, the manner and position in which increasing and decreasing took place in the pattern and the affixation of new elements (knots and ties) in the beaded structure. These new elements may be new threads, but also separately beaded parts added onto the structure. Next, a description of the direction of beading and the manner in which the thread passes through the beads or the beadwork structure was given. It is important to note that the direction of the thread in the construction method and the visibility was often obscured because the thread was often only visible inside the perforation of the beads. Two different techniques may result in identical objects

and even when the beadwork is opened, the string visible between the beads may provide no indication of which of the techniques were used. The clue to the construction method may often only be revealed by taking the object – or part of the object – apart, or by very close examination. Since this could not be done in the Tutankhamun case study, in the future, more non-destructive methods will need to be tested to be able to conduct this part of the research. The direction of the beadwork that could be discerned added to the understanding of the production process. It also contributed to a description of the active and passive elements in the work, the tightness of the pulling and the way in which threads are cast off (use of knots and the redirecting and finishing of the thread). When the strain on the original beadwork can still be observed, this may be an indication of the pace of the work, the experience of the producer and the quality of the beadwork. Here, a parallel with other technological studies (such as basketry) may be made. The affixation of new string or other binding material and the manner in which this is done is often passed on from generation to generation by apprenticeship. It may be very specific and therefore provide us with evidence on tradition (Wendrich 1999:391). In the production of beadwork, the shape of the object may be formed by means other than by increasing and decreasing, for instance by differential strain on the binding material, or by using molds. Also, symbols or apparent features in the construction are specifically noteworthy in the process of understanding the objects as a whole. One example is apparent sloppiness in the work, functionality of repairs or deliberate mistakes. The construction level of the work will therefore provide clues on the pace, the rhythm of the production, the experience of the beader, the originality of the work, the style, the quality of the work and the rarity of the object.

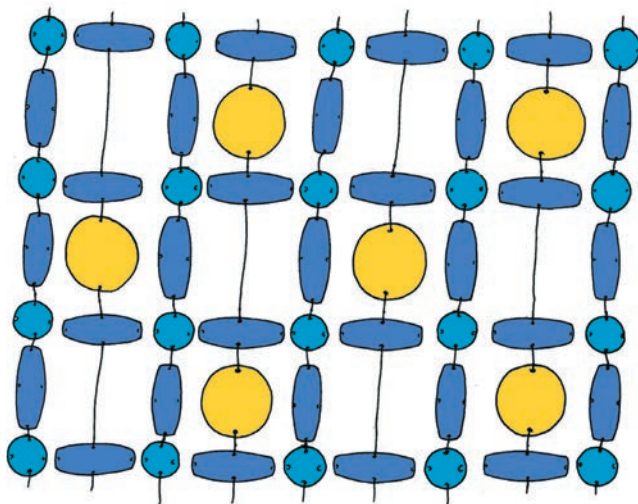


Figure 9.2 Schematic drawing of the 21d bead net pattern, showing separately strung strands of beads as laid on the textile before being sewn unto the tunic (illustration by Jolanda Bos).

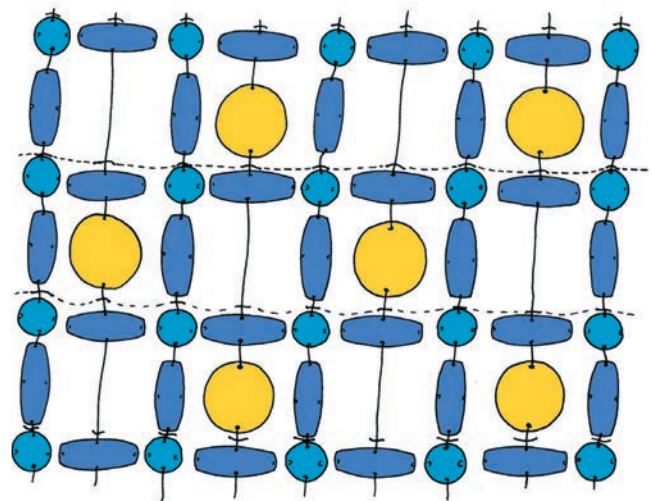


Figure 9.3 Schematic drawing of the 21d bead net pattern, showing the strands as sewn to the tunic (illustration by Jolanda Bos).

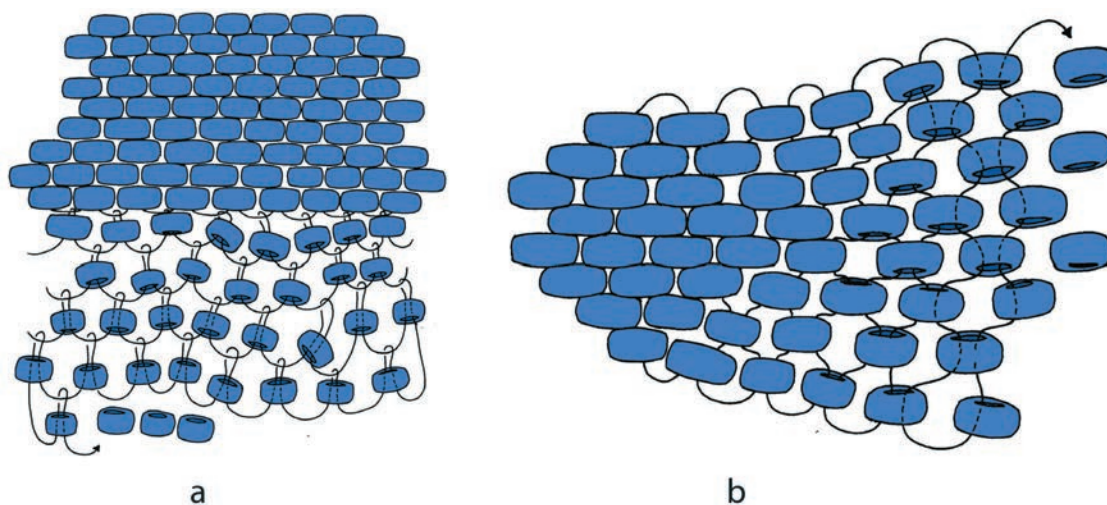


Figure 9.4 Schematic drawing of: a. a brick-stitch; and b. a one-bead netting method as used in the Tutankhamun beaded bands on tunic 21d (illustration by Jolanda Bos).

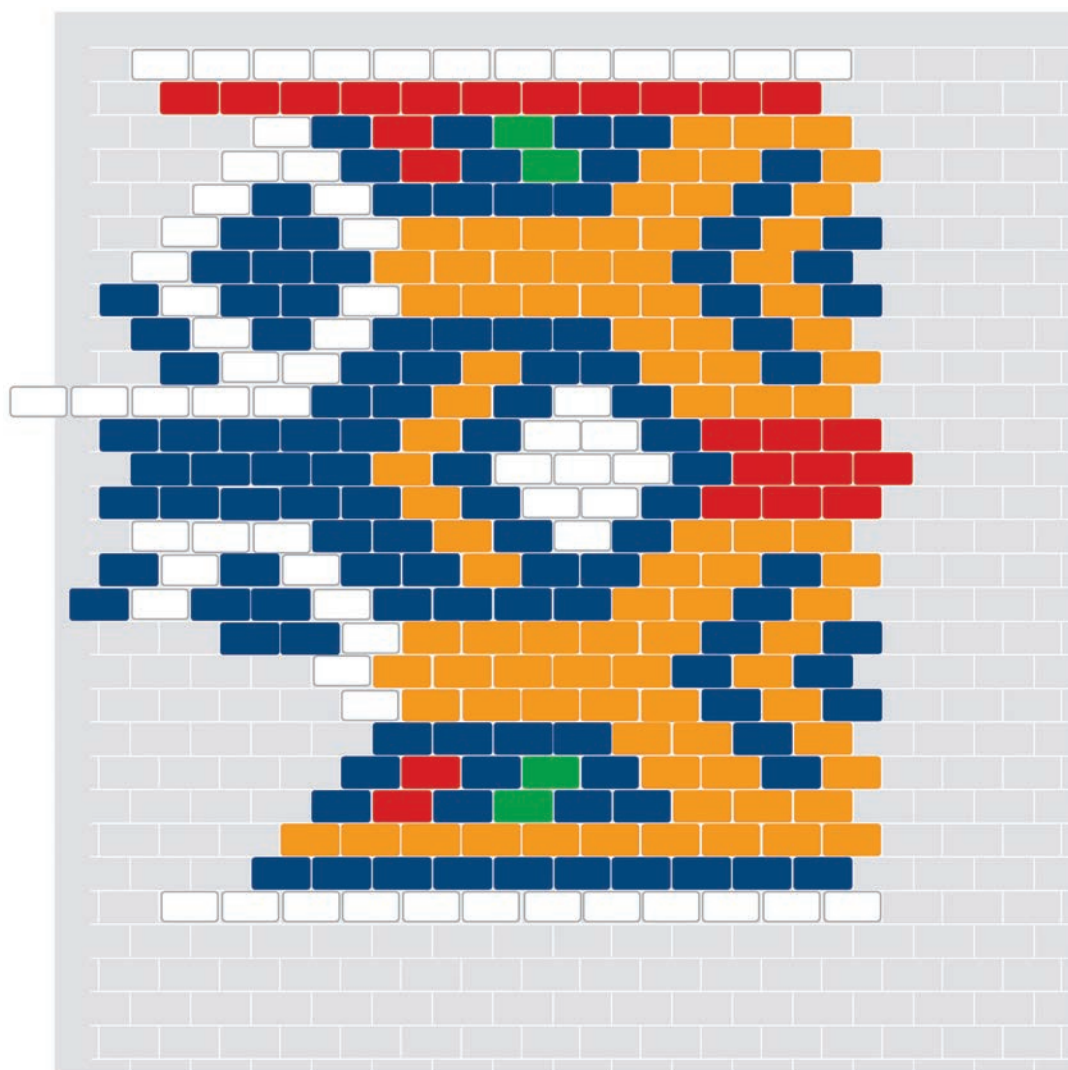


Figure 9.5 Schematic drawing of the pattern one of the beaded bands of tunic 21d (illustration by Jolanda Bos).

Thirdly, on the pattern level, a schematic account of the number of beads, the specific order of the bead combined with the use of colors and different shapes of beads is described. These elements may be summarized as the ‘order’ in the pattern. Here, the use of a schematic drawing proved to be a must. Apart from the order in the pattern, it was important to describe the orientation of the beads (the perforation) in relation to the entire object, as well as the coarseness of the fabric. The position on which the increasing and decreasing took place while making the object was indicated in this pattern description as well. This is strongly intertwined with the shaping of the object.

The Tutankhamun Case Study

The Variety of Beaded Objects from the Tomb of Tutankhamun

Completely preserved ancient Egyptian artifacts constructed with beads are mostly uncovered in funerary contexts, although from the New Kingdom onwards, large quantities of loose beads are also found in settlement sites. Complex beaded objects and beaded objects other than jewelry are most often associated with royal burials or tombs of noblemen. The ancient Egyptians used beadwork for a great variety of objects. Among them are clothes decorated with or constructed entirely of beads, girdles or kilts, sandals, head covers, hassocks, jewelry and other decorative elements, for instance hair decoration or decoration on pottery. Most of these objects were also recovered from the tomb of Tutankhamun (Carter and Mace 1923–1933; Murray and Nuttall 1963). Because of the limited amount of time Howard Carter had to excavate the tomb, none of the beaded objects were restrung, as was often done in those days. In order to preserve objects too fragile to lift, a liquid wax was poured over the objects. When cooled, the wax consolidated the beads as well as the remnants of the string used in the construction. Only beaded artifacts that had in antiquity been placed directly on the king’s body were not consolidated with wax because of the detrimental effects the wax would have had on the mummy. A broad collar constructed of tiny glazed beads was thus essentially lost when the collar was removed. Besides the collar, a beaded skullcap was left on the mummy without extra preservation measures. Even though the process of consolidating beadwork with wax is irreversible, the situation of this tomb is unique for the beadwork analyst since a large variety of beaded items and their construction techniques were preserved down to the present day.

A Tunic from the Tomb of Tutankhamun

In 1996, with permission and cooperation with the Cairo Museum (Egypt) and the Textile Research Centre in Leiden (the Netherlands), a study was conducted on the beaded textiles from the tomb of pharaoh Tutankhamun.

His wardrobe was partially reconstructed and displayed in an international exhibit (Vogelsang-Eastwood 1999). Interestingly, his textiles and beadwork had never before been a subject of study. In the process, the above-described system for documenting and analyzing beadwork was developed and used. Two of the pharaoh’s tunics were selected for further research and reconstruction. Research questions for the beadwork analysis included: can the construction of the individual fragmented objects still be determined and if so, what is their construction method and the pattern? What can the technique, pattern and execution of the construction tell us about the production process, the use and discard of the artifacts? What can be said about the beadwork in relation to the period in which it was made? Were the construction and the pattern Egyptian or might the tunic be imported? What general remarks or characteristics of this particular object may be noted? Although the study was not yet finished, in 1996, replicas of two tunics (21d and 44w) were reproduced and displayed in the exhibit, Tutankhamun’s Wardrobe, and the research was continued afterwards. One of the subjects of the research is tunic 21d. It is not possible to describe the analysis here in detail, but certain characteristics of the beadwork are worth mentioning. Below, the three parts of the documentation scheme are used to describe the most important outcome of the analysis.

Object Level

A tunic heavily decorated with beads was found in one of the boxes found inside the tomb of Tutankhamun (labeled as box no. 21 by Howard Carter’s team), (Murray and Nuttall 1963:1) (on display in the Cairo Museum: JE 62634). The beads make up a beaded net at the front of the gown and beaded bands at both sides and the front center of the garment. Carter and his team categorized the remains of the tunic as 21d. Carter reports in his notes, all published on the website of the Griffith Institute, that this tunic was found in partially good condition (Anatomy of an Excavation, Griffith Institute Tutankhamun 2007). Tunic 21d was found folded up inside a box containing many other objects, most of which were clothes or ornaments the king probably used during his lifetime. Among them were sandals, beaded collars, girdles, gloves and loincloths (Reeves 1990:157). Box 21 is a painted wooden box, elaborately decorated with hunting and battle scenes, found inside the antechamber of the tomb. Tomb robbers in antiquity almost certainly moved the box from its original location to where it was found in 1922, standing north–south just to the right of the entrance to the burial chamber, next to one of the large wooden statues. Whether the content of the box was partially pillaged in antiquity is not certain. It seems that the tunic was worn by the king during his life, since Carter notes wear marks on the cloth of the tunic. The tunic is made of linen, covered with variously shaped (Egyptian) faïence or glass beads and gold sequins (Bos 2007:57). Long tubular

plano-convex beads made of Egyptian faïence, with multiple rectangular cross perforations in one plane (Beck perforation type X.e) and circular plano-convex beads, with the same perforation (Beck type V.C.1.a) make up the bead netting. The bands on the side of the tunic consist of small, standard short barrel beads, type I.B.3.b (Beck 1928). The beaded net is decorated at the bottom with tassels constructed of strands of standard barrel beads and standard concave cone beads (Beck I.B.3.c) at the end of each tassel. The fibrous thread used in the beadwork has not been analyzed, but is likely to be linen. Carter went through some trouble to preserve as much of the fabric as possible when lifting the object. Other objects from the box were lifted first, and lastly wax consolidated the find of the tunic in its folded position. The hardened material was then lifted and stored for further study.

Construction Level

Roughly two construction methods are visible on 21d, between them displaying a very different construction pace. One technique is the net pattern at the center of the garment; the other is the technique producing the beaded bands at the edges and the center of the tunic. It appears that enormous effort was put into the production of the bands at the center and at the edges of the garment. This contrasts sharply with the effort put into the production of the bead net sewn onto body of the tunic. From the folded remains of the tunic, now in the museum in Cairo, the manner in which the tube beads were sewn can still clearly be distinguished. It is a remarkable fact that the net pattern in 21d is sewn perpendicular to the bands of the tunic and not, as is most often the case, diagonal to the sides of the fabric. A simplified stringing method was used in 21d, not attested anywhere else in bead net production in Egypt. All other known Egyptian net patterns seem to have been produced in a different manner (Hall 1986:65; Janssen 1995:44; Jick 1988:79, 1996:74). The specific technique used in tunic 21d, however, facilitated a rapid production process of what was meant to resemble a traditional Egyptian beaded net pattern. Long strands of vertically placed tube beads strung alternately with circular beads, and adjacent strands of gold sequins and long tube beads placed horizontally, were laid out on the garment perpendicular to the vertical beaded bands (Fig. 9.2). The golden sequins are not placed inside each mesh of the net, but were placed inside the meshes alternately, in a checkerboard pattern. These strands were then fastened to the textile with course stitches – sometimes passing through the perforation of the tubular beads of the crossing strings in the net pattern – binding together the strings of beads in a net pattern. The netted fabric, thus, does not consist of a net constructed row by row and sewn onto the garment's linen after production; rather it consists of separate strands without joint cohesion, sewn onto the fabric, resembling a beaded net (Fig. 9.3). From a full reconstruction of the beaded tunic

in the research it became clear that an experienced beader could produce this netted fabric within a single day, whereas the production of a beaded net constructed row by row, is considerably more time-consuming.

The beaded bands on the same tunic (21d) were constructed differently. Here, small beads were used to build a closely constructed fabric. The construction method could not be determined with certainty. The work is constructed very tightly, obscuring the details of the technique making close examination of either the beadwork edges or the passing of the thread difficult. However, it is clear that either a brick stitch or a one-bead netting method must have been used, for instance as described by Crabtree and Stallebras (2002:178, 191). Between these two construction techniques, the method as well as the orientation of the work is different, but a similar appearance can nevertheless be produced (Fig. 9.4a–b). In these techniques, single beads are strung in staggered rows, either horizontally or vertically. Having been able to identify other techniques from ancient Egypt, however, and considering the shape of the pattern and the length of the bands constructed here, it is likely that the one-bead netting method was used in the production of these beaded bands. Here, a flexible fabric is created by adding each individual bead in the spaces created between the beads of the previous row (Fig. 9.4b). This way, the binding material both passes through the beads of the previous row and the new bead alternately. The vertical decoration pattern is another indication that the beaded fabric was indeed constructed vertically and contributes to the idea that a one-bead netting method was used. In long, narrow beadwork, vertical decoration is easily created using this technique. If more fragments of the bands had survived, the tightness of the beadwork may have revealed the presence of separate hands, but this is not the case. The pattern of the beaded bands is complex and differs in the center band from the bands on the edge and the bottom of the garment. At the center, a geometrical pattern is laid out in small glass (or Egyptian faïence) beads and two bands are sewn together lengthwise. At the edges, near the arms, the bands show stylized protective feathers composed of the same beads (Fig. 9.5). At the bottom of the garment the beads display a lozenge shaped pattern. From the weight of the reconstructed bands it became clear that the bands were not attached to a seam at the side of the linen tunic. The bands were most probably sewn onto the tunic's extremities, with the linen of the tunic supporting the weight of the bands. From the reconstruction made during the analysis it seems that more than 300 man-hours were invested in the construction of the bands. The contrast between the efforts put into the beaded bands and the appearance and effort put into the production of the bead net is therefore remarkable.

The outcome of this part of the analysis may also be an indication of the pace and the rhythm in which this garment was produced. Because of the different methods used in the production of the net and the bands, it may be speculated that the elements were made separately by

different beaders, possibly even at different times. The bands, fragmented but still on their original thread, display very regular workmanship (Fig. 9.6). They seem to have been made with extreme attention in a time-consuming manner. They may also have been constructed separately from the tunic and from each other. The net pattern was made with less attention to the careful positioning of the individual beads and without minding whether the string was visible, facilitating fixation of the different strands. It is also noteworthy that not all perforations in the beads of the net pattern were used in the production of the net (Fig. 9.7). The beads of the net all have perforations in more than one plane. In most cases, only one perforation was used. If all perforations had been used, the beadwork would have been more consistent and tightly strung. Therefore, although certainly not a disqualification of the appreciation of the work in antiquity, the bead net pattern seems to have been deliberately made quicker than was planned, judging from the choice of material.

The bead net could not have been produced without the tunic and it can be determined from the construction that it was attached later than the bands; only when the bands were in place could the exact size for the net and the positioning of the strands been established. It is therefore clear that the bands were produced before the netting. How much earlier they were produced remains unknown of course, but considering the inconsistency in the work, it appears that the bead net was a much later addition to an earlier tunic decorated only with bands and added perhaps for funerary purposes. Even the gold sequins, on similar tunics applied carefully to fill up the spaces as a last construction element, were strung here at the same time as the bead net tubular beads. The beads were attached on one string with the tubular beads and later attached to the linen with a separate yarn (Fig. 9.3). Given this working method, it can even be suggested that several beaders worked on the production of this net fabric simultaneously. Several individuals may have laid their separately strung strands on the tunic and yet another person may have sewn the strands onto the textile with coarse stitches between the strands. Obviously, it is impossible to conclude with certainty that the tunic was actually constructed by different beaders simultaneously, but the fact that a much more coherent result (consistent with the thoroughly constructed beaded bands) could have been achieved, is evidence that the production process was deliberately speeded up in this way. The question remains, of course, why this method of speeding up the construction process of the beaded net was chosen? To answer this question the function of beaded net fabrics in Egyptian burials was examined.

Pattern Level

Tunic 21d is, at least in the front of the fabric, decorated with a net pattern of turquoise colored beads fitted in between the beaded bands of the tunic. The meaning of

such patterns in funerary contexts is not unambiguous. Fabrics with a net pattern like tunic 21d appear in burials throughout Egyptian history, from the Old Kingdom to the Late Period. Similar patterns were often painted on coffins in Graeco-Roman times. Net fabrics are usually made of turquoise, Egyptian faïence beads or even lapis lazuli beads (for instance Cairo museum JE 35923). At least in the Late Period, from the 22nd Dynasty onwards (945 BC), beaded nets seem to have been a prerequisite for the burial as exterior mummy decoration, while in earlier times beaded fabrics are only found occasionally in tombs. An example of an early appearance of a net fabric is a bead net dress found in a female burial in Giza tomb G7440Z dating to the 4th Dynasty (2575–2465 BC) (Jick 1988, 1996). Here, it is evident that this beaded dress was meant to clothe the mummy, possibly part of the Egyptian costume of that period. These beaded dresses are also found painted on group statues from tombs dating to the Old Kingdom (2575–2134 BC).

Another of these dresses was found at Qau, dating to the 5th Dynasty, now reconstructed and on display in the Petrie Museum in London (UC17743). With these isolated occurrences, it is almost impossible to determine the symbolism behind the objects although much has been said on the possible erotic meaning of these dresses (for instance Janssen 1995). It has been suggested that in the subsequent Middle Kingdom (2040–1783 BC) beaded dresses were worn by women during their lifetime over a V-necked linen dress or over a wrap-around dress with shoulder straps, in order to create a more ornate dress (Vogelsang-Eastwood 1993:127). These dresses are mostly depicted in paint being worn by offering bearers found as statuettes inside tombs. This can for instance be seen in statuettes of offering bearers in the Cairo museum (JE 35923–CG 53668 and JE 46725). It has been hypothesized that this dress was associated with dancers, creating a sensual effect, although as Vogelsang observed, this idea is largely based on assumptions. In the Middle Kingdom (12th Dynasty, 1991–1783 BC) the paintings on the outer side of the coffin of Khnum-Nakhte show the first signs of net patterns associated with burials and the mummy proper (Deir Rifeh IIa, excavated by Manchester 4740) (Ikram and Dodson 1998:202, fig. 255). In the New Kingdom (1550–1070 BC) there is a decline in the depiction of this dress, unless worn by gods (Isis, Nephtys, Neith, Selket, Nut, Hathor, Maat, Goddess of the West, the cow Mehet-Weret, Orsiris and Ptah-Sokar-Osiris, all associated with birth, death and rebirth) or queens (Arnst 1998:89). In the New Kingdom, a net pattern with geometric designs around the edges, similar to tunic 21d, is found on ceiling decoration inside tombs (Riefstahl 1944:43). And, of course, another beaded net tunic was found inside the tomb of Tutankhamun (catalogued by Carter as 44w, Cairo Museum: JE 62659, JE 62653). When depicted in paint, the nets also incorporate small gold sequins between the meshes of the net. In the Late Period, rectangular beaded nets replace the nets as dress or as tomb and coffin



Figure 9.6 Photograph of the beaded bands at the sides of tunic 21d (used with permission of Griffith Institute, University of Oxford).



Figure 9.7 Photograph of the content of box 21, showing the folded tunic with beads (used with permission of Griffith Institute, University of Oxford).

decoration (Andrews 1984). They are laid out directly on the wrapped mummy and take on various shapes and complexity in design. They may be rectangular with a tightly beaded row of tubular beads as a border – see for instance the objects FAI.VL.00293, FAI.VL.00294, FAI.XL.00347, FAI.VL.00344, FAI.XL.00346 in the Senusret Collection (Virtual Egyptian Museum). Sometimes nets made of plain string covered the mummy (Janssen 1995:46). However, the bead nets may also incorporate (often beaded) depictions of the Four Sons of Horus, the Sky Goddess Nut or Isis and Nephtys, as well as a beaded face of Ra, a *Wesech* collar, a winged scarab and even text panels strung into the beaded fabric and placed on the chest of the mummy. The nets became increasingly popular in the 25th and the 26th Dynasty (712 BC onwards). In the Graeco-Roman era the nets are often replaced by cartonnages with similar painted bead nets including the Sons of Horus (for instance the mummy covering of a child BM EA 29588 as well as one from Akhmim BM EA 29584) (Ikram and Dodson 1998:186–187). In this period, it can be assumed that the beaded fabrics were thought to protect the body of the deceased (Taylor 1988:175). Several authors have hinted at the association between the net pattern and the magical; the

protection against evil (Bosse-Griffith 1978:156; Hornblower 1930:17; Riefstahl 1944:11; Taylor 1988:175). However, the research that Arnst has conducted into the symbolism behind the nets gives a clear insight into the role and function of these amuletic objects. She states that:

Das Mumiennetz ist wie jedes Symbol etwas “Zusammengeworfenes”. Auf materieller Ebene ist es ein Fanggerät, mit dem auch Feinde gefangen und tödliche Gefahren abgewehrt werden können, quasi ein “Ganzkörper-Amulett”. Auf metaphysischer Ebene symbolisiert es die Verwandlung, den Durch und Übergang von der diesseitigen in die jenseitige Welt. Es ist ein hochkomplexes, vielschichtiges Symbol, weil es nicht nur mehrere Bedeutungsmomente gleichzeitig enthält, sondern mit anderen, ebenfalls komplexen Symbolen ein Beziehungs- und Bedeutungsnetz bildet. Und – nicht zuletzt – ist es ein ganzheitliches Symbol, weil es die erhoffte Transformation in einen kosmischen Zusammenhang einbettet: durch die Angleichung an die Sonne, ihren ewigen Kreislauf von Geburt-Tod-Wiedergeburt, suchten die Ägypter

im Tode Anschluß an das Göttlich-Erhabene und die himmlische Unendlichkeit (Arnst 1998:90).

The golden disks often going with the pattern conform with the solar symbolism she describes, dazzling between turquoise tubular columns of the netting. It seems possible therefore that beaded nets might have been a prerequisite for the burial of Tutankhamun.

Tutankhamun died in his youth and, as accepted by most Egyptologists, quite unexpectedly. Much has already been speculated about his death, burial and subsequent succession. Although nothing more than a speculative thought in addition to the ongoing discussion about the pharaoh's burial, based on the analysis of tunic 21d, the suggestion can be made that the bead net fabric sewn onto tunic 21d might have been an addition around the time of the burial to an existing and used tunic originally only decorated with beaded bands of protective feathers and lozenge patterns. In this particular situation, the decoration with a netted fabric may be an add-on for the purpose of the burial, thus, ensuring the king was given netted fabrics to be used for magical purposes after death. This may explain the technique of the beaded net pattern, possibly produced at a hurried pace, as the content of the burial was already being prepared.

Summary

Beadwork from archaeological contexts has rarely been studied thoroughly in the past and many beaded objects were restrung or lost without proper documentation or analysis. In this article, the first outline has been presented of a system for recording and analyzing, not only the appearance of a beaded object from ancient Egypt, but also the entire process of design, construction, meaning, function, use, possibly secondary use and discard of a beaded artifact. With the use of this recording system, the complete object, the construction and the pattern can be described and a more complete image may be created of beading as a craft and the role of beadwork in ancient culture. The system was designed while working on material from ancient Egypt, but it will be applicable to sites of any period in which beadwork is found.

In a specific case study, of a beaded tunic from the tomb of Tutankhamun, a different interpretation of this object could be developed through this type of analysis. The patterns, as well as constructional aspects, were analyzed in relation to the function of beaded nets in funerary contexts. The analysis emphasized decisions made by the producer(s) of the garment, and presented possible explanations for it. The discussion centered on the question of why the tunic, clearly worn by the pharaoh in his lifetime, was made with such inconsistency in the appearance and speed of the manufacturing work. It seemed reasonable to suggest (although with caution) that this garment may have been adjusted for the funeral, possibly as (a prelude to) a newly

emphasized element in funerary custom. From studies into the symbolism and use of beaded nets in ancient Egyptian society, it became clear that the net pattern provided protection and aid in the afterlife and incorporates many references to birth, rebirth and solar elements. Given these symbolic roles, it is also unlikely that the tunic is a foreign addition to the burial. Although beaded nets occur most frequently in burials of the Late Period, the pattern and its symbolism is much older and on the tunic found in the tomb of Tutankhamun may well have served the function of a protective amulet. The inconsistency in the execution of the beadwork of tunic 21d, combined with the symbolic meaning of net patterns, shows the role beadwork analysis may play in the interpretation of very specific archaeological situations.

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Part 3

Methodological Approaches

A Mother-of-Pearl Shell Pendant from Nexpa, Morelos

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Abstract: *A nacreous shell pendant discovered at San Pablo Nexpa, Morelos, Mexico, is one of the oldest shell pendants known to date in Mesoamerica. Found in a burial context dated to the Early Formative period, sub phase Early Nexpa (1359–1250 BC), the artifact has a representation of two lizards carved in high relief. In this paper, we present recent analyses of this piece, including the biological identification of the shell and the lizards represented, as well as the manufacturing techniques used to produce it, studied through experimental archaeology and scanning electron microscopy. Based on these data, we discuss aspects of the cultural affiliation of the piece, its high value and the exchange routes that enabled the circulation of prestige goods in the Formative Period.*

Introduction

From 2500 BC to AD 200, during the period known as the Formative or Preclassic, the cultural area known as Mesoamerica underwent a series of important social changes that led communities with egalitarian systems to develop organizations in which certain groups of individuals controlled political and economic power (Piña Chan 1976:44; Serra Puche and Sugiura 1977:24). The rising elite concentrated and regulated the procurement and distribution of goods, and they prominently displayed and maintained their high ranking position through prestige items (Drennan 1998:26). The acquisition of precious, rare, and difficult to acquire materials and pieces implied complex exchange networks to secure the raw material or the finished products. In this process, groups of people became increasingly exempted from subsistence activities to craft complex objects used by the elite to flaunt their high social status; as a result, from that time forward, specialized groups of master artisans arose (Serra Puche and Sugiura 1977:24).

One of the materials employed to create prestige items in Mesoamerica, since the Formative Period to the Late Postclassic (AD 1325–1521), was the mollusk shell (Solís 2007; Velázquez Castro et al. 2008). This study presents

the results of analyses conducted on a pearly shell pectoral found in a burial in Nexpa, Morelos that clearly reflects the social changes that took place during the Formative Period in Mesoamerica.

Provenience of the Piece

The piece in question, which is now in the Preclassic collections in the National Museum of Anthropology in Mexico City, was found in Nexpa in the state of Morelos. It is a site located west of the Cuautla River (also known as the Chinameca), which originates in the northern part of the state, south of the slopes of Amecameca, and continues southward, toward the border between Morelos and Guerrero, where it joins with the Amacuzac River, which is one of the major tributaries of the Balsas drainage system (Grove 1974:3).

From 1969 to 1970, David Grove excavated the Preclassic villages of San Pablo and Nexpa (Fig. 10.1), where he found a large number of burials that contained offerings (Grove, 1970). In one of them, uncovered in Nexpa and designated NC-3-L (Grove 1974:27, fig. 13a–g), corresponding to an adult individual buried in an extended dorsal position with the head oriented toward the west, a shell pectoral with

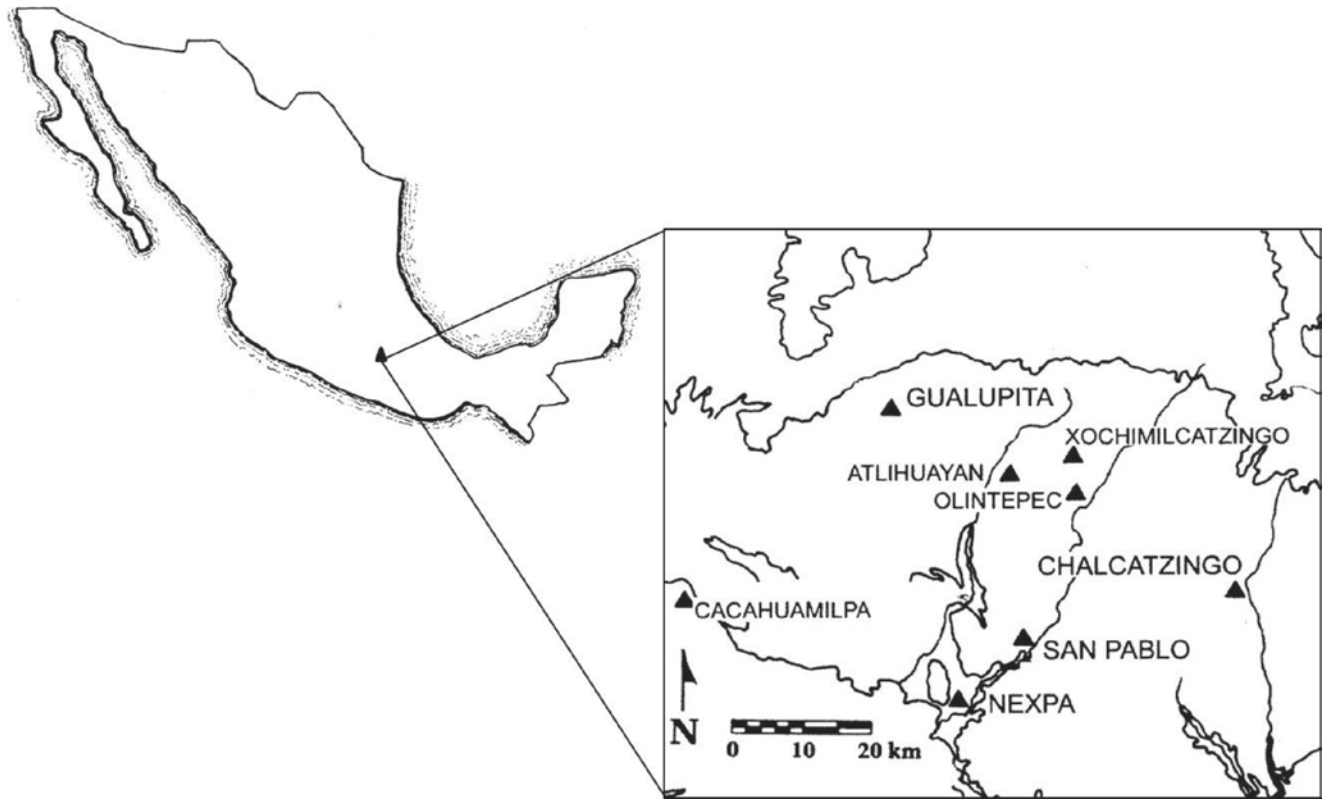


Figure 10.1 Map of location of Nexpa, Morelos (adapted after Grove 2010).

two lizards in bas-relief was found associated with the mandible.¹ One of the animal figures had what might be a piece of hematite inlay in its eye. Other elements forming part of the funerary offering were a brown ceramic pitcher with divergent walls and a dark gray vessel with a flat base, divergent walls and rocker-stamp decoration, in the interior of which were found four ceramic stamps.

Based on the type of offering, particularly the vessel with rocker-stamp decoration and the stamps it contained, this burial is believed to date to the Early Nexpa subphase of the Early Formative Period, corresponding to 1350–1250 B.C. (Grove 1974:30). As such, it is one of the earliest burials at the site.

Description of the Piece

The piece in question was worked from the nacre of a bivalve shell measuring 13 cm long, 10.3 cm wide, and

2.5 cm high. The external layers of this specimen were removed to leave the inner mother-of-pearl exposed; similarly, the edge of the shell was abraded to give the piece a, more or less, oval shape. Two almost identical zoomorphic representations were worked in high relief on the dorsal surface of the shell. They show a pair of creatures, seen in profile, arranged back to back as if a mirror reflection of each other, displaying slender bodies, long tails, flexed legs, and long toes. A distinctive feature is the protuberance on the back part of the lizard's head that resembles a shelf. The details of the toes and the mouth were drawn with incised lines; the eyes were produced by circular abrasion, one of the eyes retains inlaid material (Fig. 10.2a). The hinge was abraded on the inner part of the valve and there are three conical perforations in the fold in front of it (Fig. 10.2b).

The worked shell is clearly a marine bivalve of the Pteriidae family, which typically has pearly interiors; the species is *Pinctada mazatlanica*. This species is distributed in what is known as the Panamic Malacological Province, which spans the Pacific coast of the American continent from south of the Baja California Peninsula, including the Sea of Cortés (also known as the Gulf of California) to northern Peru; it dwells on rocky substrates in shallow waters (Keen 1971: 79). In the case of the Nexpa pectoral, the diagnostic traits used to identify the shell species from which it was

¹ Unfortunately this burial was not discovered during the archaeological excavations but instead some were found shortly afterwards by workers. However, Grove included it in his study because the offering materials were preserved as a group and were of major interest from the chronological point of view. Information on the position of the body and the arrangement of the objects was provided by an informant (Grove 1974:27).

made were the mother-of-pearl, the single muscular scar characteristic of an adult specimen of the Pteriidae family, and the distinctive straight hinge flanked by two symmetrical projections or wings, one large and the other small, which can be seen despite the modifications made to the specimen (Fig. 10.3). It is a left valve of the specimen, which must have been a large, thick-shelled adult. It is worth noting that the pectoral measures 13 cm in length, while the maximum length currently reported for this species is 10–12.5 cm.

Pinctada mazatlanica was one of the species preferred by ancient societies in Mexico for use in the production of such status marker objects. Later, it was exploited for the quality of the pearls it produced, while the shell was used to manufacture buttons, fans, and an array of ornaments, a practice that has continued to the present.

The two animals represented on the Nexpa pectoral are reptiles that belong to the Corytophanidae family of helmeted lizards of the species *Laemantus longipes* (sometimes referred to as eastern casquehead iguanas) that characteristically have a slender body with long tail, a head that has a well-marked triangular shape in profile (*canthus rostralis*) that projects in the back part of the head forming a shelf-like protuberance; the feet are also long with elongated toes (Fig. 10.4). They can be found on the tropical slopes of Mexico, on the Gulf Coast of Mexico from southern Tamaulipas to the Yucatán Peninsula, and on the Pacific from southern Sinaloa to the coast of Chiapas, reaching inland in the Balsas river basin to the state of Morelos (Flores-Villela 1993:23).

Technological Analysis

The analysis of the techniques used to produce the Nexpa pectoral was conducted as part of the project “Técnicas de manufactura de los objetos de concha del México prehispánico” (PTMOCMP; Manufacturing Techniques for Pre-Hispanic Mexican Shell Objects). Given the frequent absence of clear, direct indicators of production techniques in archaeological materials, this project studies technology through experimental archaeology, replicating the modifications (abrasion, cuts, perforations, openwork, incisions and surface finishes) made in antiquity by working modern shells of the same species as those used in pre-Hispanic times to produce conchological objects. Materials and tools described in various sources (archaeological finds, historical sources, studies by other researchers) are employed based on the supposition that they were used in the past. To make the transition from the purely conjectural to the level of proposing the procedures and tools used in the past with greater certainty, the manufacturing traces produced under experimental conditions are characterized and compared with features present on archaeological pieces. This process is carried out using three levels of analysis:

macroscopic (the naked eye), stereoscopic microscopy at low magnification (10×, 30× and 63×) and scanning electron microscopy (SEM) (100×, 300×, 600× and 1,000×); the latter is the technique that has yielded the best results because it is ideal for the study of surface characteristics of materials. For analysis with SEM, an electron beam is focused on the sample to be analyzed, the surface of which releases a series of signals that are then captured by specialized detectors, some of which can generate high-resolution digital images. On conventional equipment, the sample chambers must have high vacuum conditions and the samples must be good electrical conductors. In more recent models, one can work in low vacuum and even environmental pressure conditions, which makes it possible to analyze moist organic samples. Initially, the study of shell objects with SEM was conducted by moving the pieces to the laboratory; later the decision was made to produce replicas of the manufacturing traces in polymers softened with acetone and covered with gold ions, a technique typical of metallography. This avoids the need to move archaeological collections, because replicas can be made in places where the materials are stored without having to transfer them; it makes it possible to examine the samples in high vacuum mode, which permits a greater degree of resolution; it also facilitates work sessions, because up to twenty-one samples can be examined in two hours; and it makes possible the analysis of pieces that could not have been introduced into the SEM sampling chamber because of their size or that presented difficulties as a result of modifications to their shape or the position of the sample (Velázquez Castro 2007).

To date, 733 experiments have been carried out. These include diverse modifications (abrasion, cuts, perforations, incisions, openwork, and surface finishes), carried out with different types of materials (volcanic, sedimentary and metamorphic rocks, flint and obsidian tools, as well as various abrasive materials). Shell object collections have been reviewed from time spans ranging from the Formative Period to the Late Postclassic, and from diverse cultural regions in Mexico (the Central Highlands, the Gulf Coast, Oaxaca, the Mayan area, west Mexico, and northern Mexico). Similarly, pieces from other countries such as the United States and Peru have also been analyzed.

Five polymers were obtained from the Nexpa pectoral, which included the dorsal surface, the edge of one of the lizards, the incision on one of the feet, and the two perforations. These samples were covered with gold ions and were examined with SEM in high vacuum mode, with secondary electron signals (SES), with 20 kV beam power with an aperture of 42 and a 10 mm work distance. Four amplifications of each polymer were undertaken at 100×, 300×, 600×, and 1,000×. Later, the micrographs

were analyzed; their features were characterized and then compared with the project's database of experiments. The results were as follows:

Dorsal surface. Fine, tenuous lines from 0.66 to 2.8 μm in thickness were observed, as well as a large quantity of particles. These traits correspond to those produced by polishing with a flint nodule (Fig. 10.5). Unfortunately, the abrasion traits from the production stage prior to the application of the finish are not discernible.

Edge. At 100 $\times$ magnification straight bands that are 50 μm wide are visible, beneath which at 1,000 $\times$, straight lines measuring 0.6 μm in thickness can be seen. The latter

traits correspond to what is produced by cuts or incisions produced with obsidian artifacts (Fig. 10.7), while the former are similar to the traces left by abrasion with andesite tools (Fig. 10.6).

Incision. Irregular features that display fine lines 0.6 μm in width on their interior can be seen. These correspond to the characteristics left by incisions produced by obsidian tools (Fig. 10.8). **Perforations.** On the two perforations, lines from 0.6 to 2 μm in thickness could be observed. These appear to interweave to produce a rough surface. This is similar to the traces left by perforating with flint powder (Fig. 10.9).

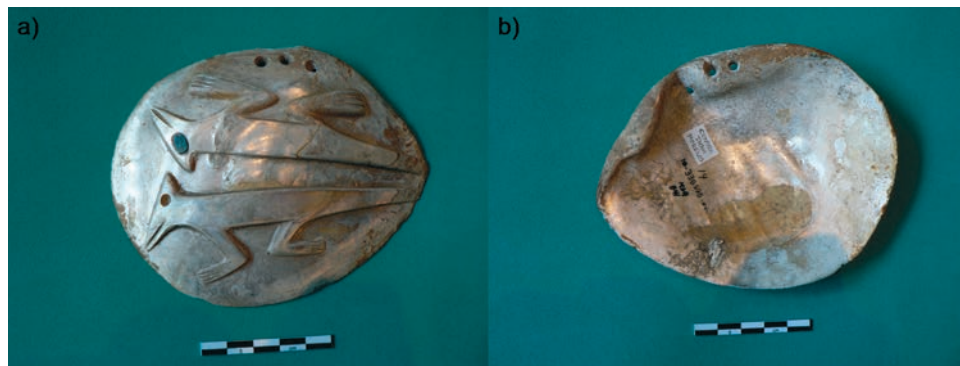


Figure 10.2 Dorsal (a) and internal views (b) of the pendant from Nexpa, Morelos (photos by Adrián Velázquez).



Figure 10.3 Views of *Pinctada mazatlanica* valves: natural state (left) and with dorsal surface abraded to reveal the mother-of-pearl interior (right) (photos by Germán Zúñiga).

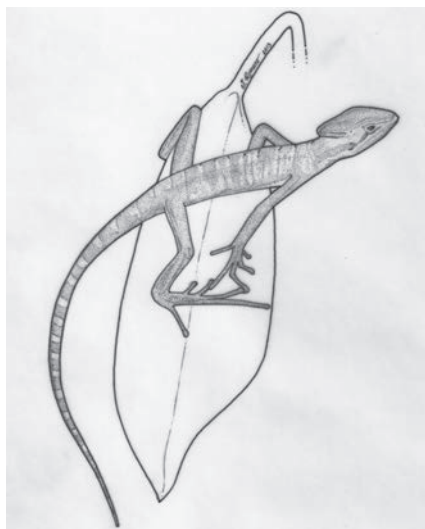


Figure 10.4 *Laemantus longipes* (drawing by Julio Romero).

Final Remarks

The Nexpa pectoral is of special interest because it is a shell piece from the Formative Period, a time when societies in the cultural area of Mesoamerica were growing in complexity with the rise of elites who required luxurious items, made of exotic materials. In the present case, the raw material is a marine shell from the Pacific coast of Mexico. Its procurement reflected values underlying the selection of the material because it is a particularly large adult specimen; the condition of the piece allows us to infer that it was collected when it was alive, perhaps during diving, because there is no evidence of the deterioration produced by the weathering of an exoskeleton swept onto the beach by the surf where it would have been exposed to environmental agents (colonization by other organisms, discoloration from the sun, and abrasion from sand and swells). It is highly likely that its arrival in the state of Morelos was via the Balsas River, which must

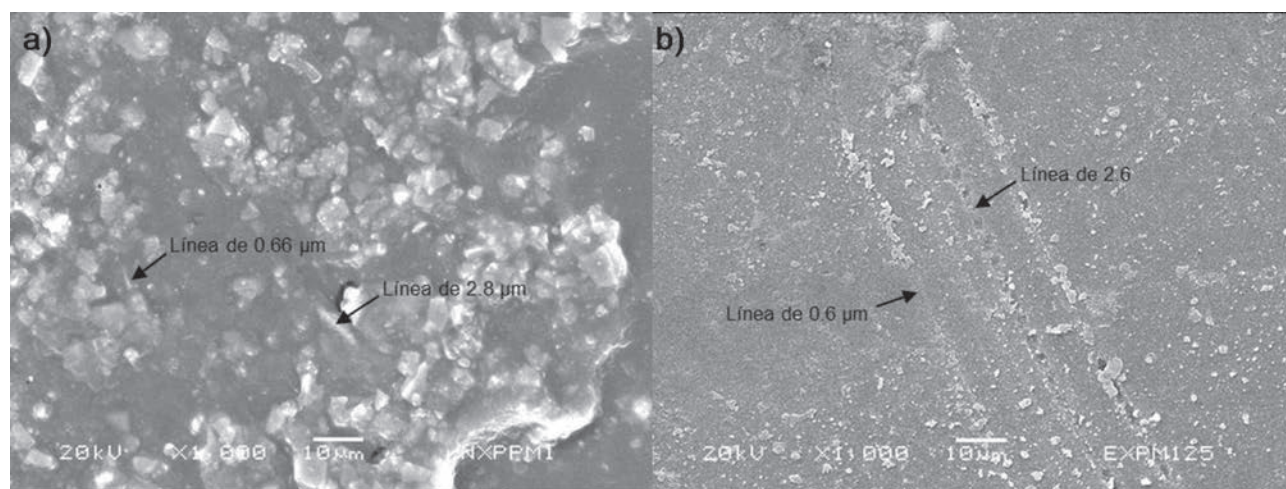


Figure 10.5 a. Surface of the Nexpa pectoral at 1,000 $\times$; b. surface of *Pinctada mazatlanica* experimentally abraded with andesite and polished with flint nodule, at 1000 $\times$ (PTMOCMP micrographs).

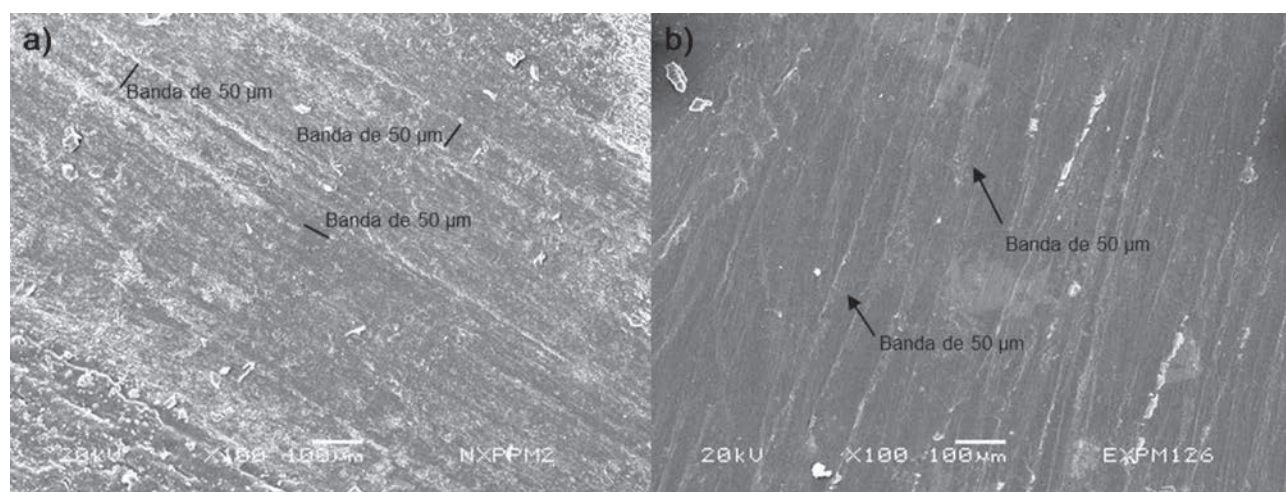


Figure 10.6 a. Edge of the relief on the Nexpa pectoral, at 100 $\times$; b. *Pinctada mazatlanica* surface experimentally abraded with andesite and polished with flint nodule, at 100 $\times$ (PTMOCMP micrographs).

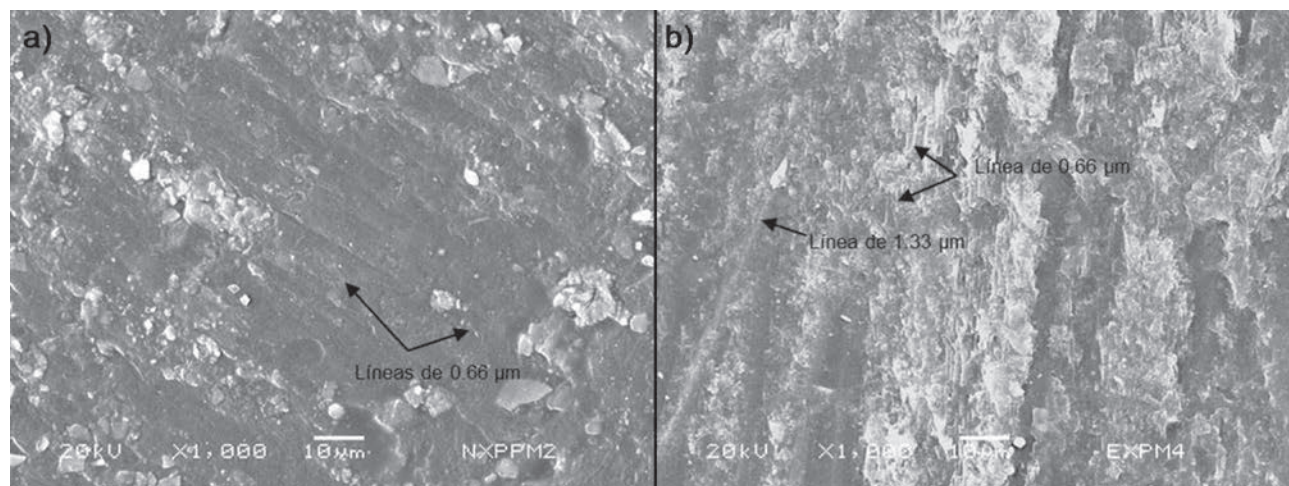


Figure 10.7 a. Edge of the relief on the Nexpa pectoral at 1000 $\times$; b. cut produced experimentally with obsidian blade on *Pinctada mazatlanica*, at 1,000 $\times$ (PTMOCMP micrographs).

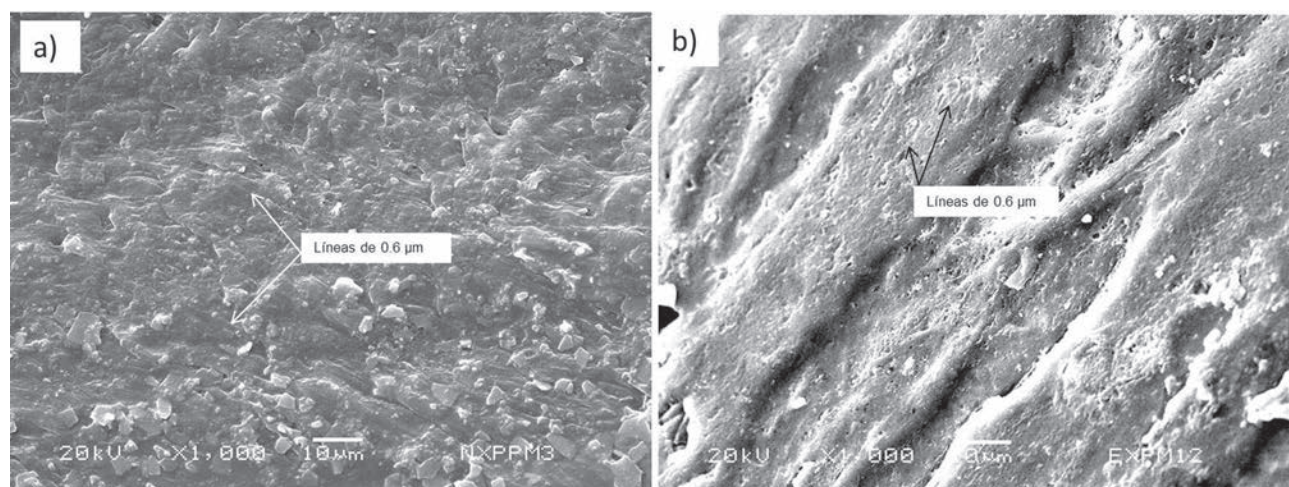


Figure 10.8 a. Incision on the Nexpa pectoral at 1,000 $\times$; b. incision made experimentally on *Pinctada mazatlanica* with obsidian tools, at 1,000 $\times$ (PTMOCMP micrographs).

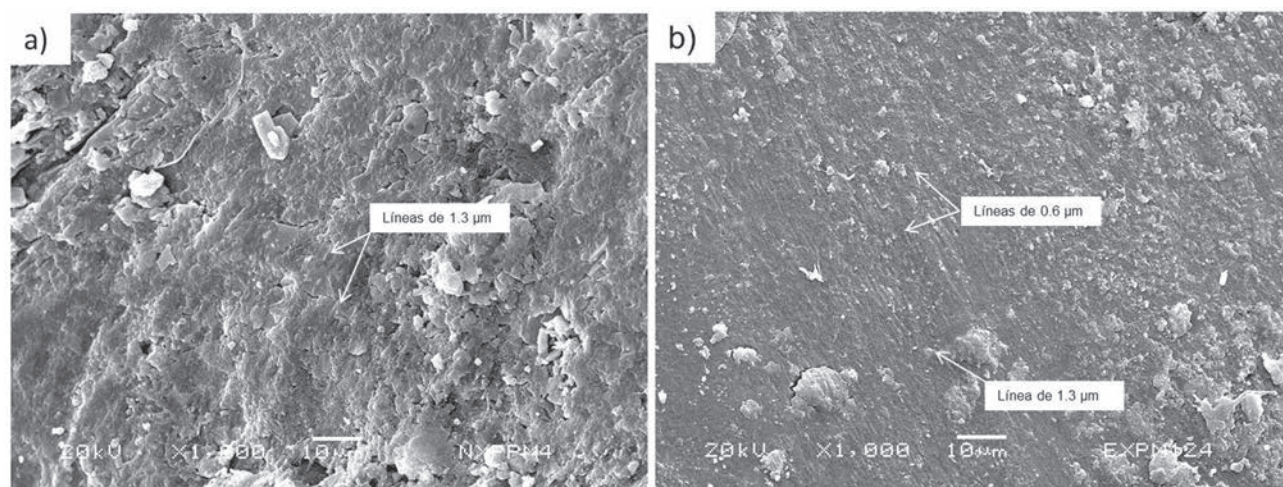


Figure 10.9 a. Perforation on the Nexpa pectoral at 1,000 $\times$; b. perforation made experimentally on *Pinctada mazatlanica* with flint powder, at 1,000 $\times$ (PTMOCMP micrographs).

have been a route that linked the Pacific coast with the Central Highlands of Mexico since ancient times. Another element that merits comment is the technological affinity that this piece displays with shell objects found at another Formative Period site located in the Balsas river basin: Teopantecuanitlán. In this important enclave, corresponding to the so-called Olmec Horizon, research carried out by Solís (2007) made it possible to identify one of the oldest shell-working industries, characterized principally by the use of Pacific specimens, particularly *Pinctada mazatlanica*. The techniques inferred by Solís include the use of andesite rocks for abrasion, obsidian tools for cutting and making incisions, of abrasives such as flint powder to perforate the shell, and the use of flint polishers. In this way, although it cannot be posited that the Nexpa pectoral was produced in Teopantecuanitlán, it is indeed possible to propose that it belonged to the same technological tradition, one of the principal features of which is the use of flint powder to perforate pieces, because to date this technique is known solely from these two centers. Another element that might support this hypothesis is the representation of the *Laemactus longipes*, which although it is a species with a widespread distribution, it is characteristic of the Balsas river basin, precisely where it enters the state of Morelos.

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Detailing the Bead-Maker: Reflectance Transformation Imaging (RTI) of Steatite Disk Beads from Prehistoric Napa Valley, California

Tsim D. Schneider and Lori D. Hager

Abstract: *We employ Reflectance Transformation Imaging (RTI), a relatively new digital imaging technique that renders three-dimensional data from a series of two-dimensional digital photographs, to identify unique manufacturing signatures represented on the surfaces of steatite (soapstone) disk beads. A total of 41 steatite beads were collected during archaeological excavations at CA-NAP-399, a prehistoric site in the upper Napa Valley of California that also contained 162 human burials and large assemblages of stone, bone, and shell artifacts. Following an overview of the project and site description, our paper focuses on the analysis of the steatite disk beads based on standard metrics and using RTI. Routine measurements on the beads demonstrated three distinct bead size classes, each associated with different archaeological contexts: an isolated find and two separate burials. Based on our findings from an RTI analysis of the largest lot of 29 steatite disk beads, we argue that distinct bead size classes and manufacturing techniques – amplified by the RTI – reflect individual manufacturing preferences by people representing a greater cross section of society than bead manufacture carried out by craft specialists alone.*

Introduction

The diminutive nature of most ancient beads requires research techniques that augment our ability to see the smallest details of the bead. Often undetectable, surface and perforation details aid in the determination of the bead's manufacture and use in past human societies; they can also provide clues to the bead-maker and to the eventual disposal of the bead in a given archaeological context. With the development of digital imaging technologies such as scanning electron microscopy, near-infrared photography, Polynomial Texture Mapping, photogrammetry, and others, a suite of digital image analyses is now more than ever a standard in the archaeological toolkit for studying the often hidden micro and macrotopographic details of material culture (e.g. Bar-Yosef Mayer and Porat 2008; Earl et al. 2010; González-Urquijo and Ibáñez-Estévez 2003; Grosman et al. 2008; Malzbender et al. 2001; van Gijn 2006, this volume; Verhoeven 2008). One digital imaging technique,

Reflectance Transformation Imaging (RTI), has emerged as a means of highlighting the surface details of objects using a series of photographs taken in a specific format and processed using specific software (e.g. CHI 2013a; Earle et al. 2010, 2011; Mudge et al. 2006, 2012; Purdy et al. 2011; Schroer 2012).

Originally developed by Tom Malzbender and others at Hewlett-Packard as Polynomial Texture Mapping (Malzbender et al. 2001), RTI has since become an important archival, conservation, and research tool for archaeologists, museum scientists, and others. RTI offers multiple views of surface details that are not easily perceived by the human eye, even with magnification, a clear advantage for bead specialists where visibility can be limited due to the small sizes of many beads. Recent applications of RTI attest to its importance for studying a variety of archaeologically derived artifacts and features. For example, Purdy et al. (2011) employed RTI to examine the antiquity and authenticity

of engravings on a piece of fossilized animal bone, thus, confirming it to be the earliest example of Pleistocene art in the Americas. Mudge et al. (2006, 2012) report on the efficacy of RTI combined with photogrammetry for recording and digitally preserving prehistoric rock art. Indeed, RTI is advantageous as it can be done in the field, whereas other digital imaging techniques require that objects be studied in controlled laboratory or museum environments with specialized equipment. Because the undistorted visual renderings of artifacts and features are visualized through an interactive post-processing mode, Earle et al. (2010:2049; see also Schroer 2012) profess an added “public face role” for RTI visualizations that can bolster public interaction and amplify interpretive programs.

RTI captures digital images from a fixed camera position using an external flash unit fired at specific angles at a calculated distance from the object (Fig. 11.1). Reflective spheres placed in each frame record the exact light positions of the external flash at each position and angle. RGB color information is also collected during this process. Using open source software (CHI 2013b, 2013c), a detailed

3-D image is rendered from the series of digital images based on the mathematical descriptions of the light vectors (“surface normals”) reflecting off the surface of the object per pixel in the image set. Forty-eight to fifty-two images of the grouped 29 steatite (soapstone) beads analyzed in this study were taken for both sides (obverse and reverse) of the beads, resulting in varying degrees of highlights and shadows depending on the angle of the external flash fired at the stationary beads. At processing, the images are rendered as a composite of the series of photographs in which the surface details are seen in high definition. While not part of the present study, RTI images can also be combined with photogrammetry to collect additional metrical attributes (Matthews 2008).

Relighting of the 3-D images post-processing using different rendering modes, or enhancement tools, in the RTI Viewer (Version 2.0.2) provides options for visualizing surface features post-processing, a noteworthy strength of the RTI technique (Fig. 11.2). Because objects have unique features depending on material type and modifications, the rendering modes customize lighting details to the specific



Figure 11.1 Capturing RTI images of an object at Cultural Heritage Imaging using a stationary camera connected to a computer. Note the handheld external flash set at specific angle and distance relative to the object and the reflective sphere in the frame. The pattern of light positions in the capture sequence is evident in the blended sphere post-processing (photos reproduced with permission from Cultural Heritage Imaging).

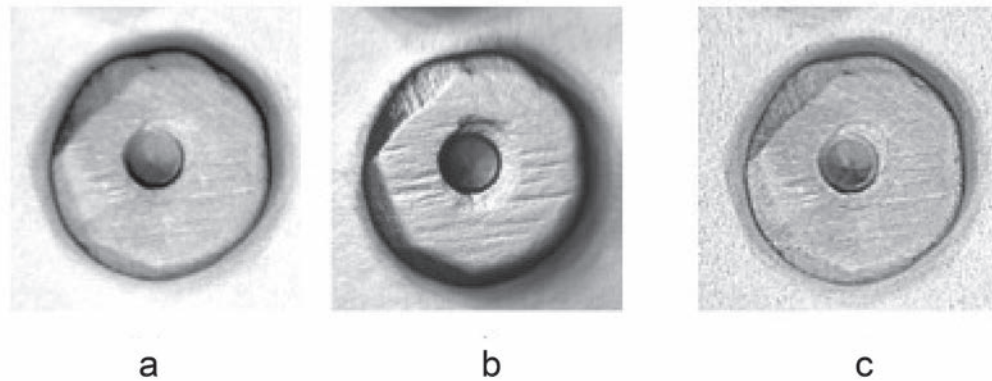


Figure 11.2 Single bead in three RTI rendering modes: a. diffuse gain; b. specular enhancement; c. luminance unsharp masking (photos by Lori Hager).

requirements under review. Out of the many rendering mode options available in the RTI Viewer program, three modes in particular – diffuse gain, specular enhancement, and luminance unsharp masking – enabled us to tailor our analysis of steatite disk beads to target specific attributes that we believe inform on bead manufacture.

In this chapter, we use RTI to study an assemblage of steatite beads collected from CA-NAP-399, a prehistoric and historic site north of San Francisco in California's upper Napa Valley (Fig. 11.3). The major features and components of the site, including 162 human burials, date to the Middle to Upper Archaic (2450 to 1950 BP) in California prehistory (Schneider et al. 2013)¹. A later component (1050 to 650 BP) of the site, consisting mainly of stone tools and containing no human burials, overlaid the older cemetery. One historic burial, interred well after the prehistoric site occupation, was discovered with glass beads and brings the total number of burials to 163. In addition to the historic glass beads, other beads collected from CA-NAP-399 include examples made from animal bone, stone (steatite), and marine shell (primarily *Olivella biplicata* [hereafter, *Olivella*]), all of which were commonly manufactured and circulated throughout prehistoric California.

The durability, ubiquity and predictability of marine shell beads, especially *Olivella* beads, lend to their importance among archaeologists as sensitive time markers and account for the substantial research attention given to them, including studies aimed at craft production or

technological specialization. At CA-NAP-399, for example, a modest assemblage of 136 *Olivella* shell beads reflects broad temporal and geographic connections to a regional network of specialists who prepared distinctly uniform *Olivella* bead types for circulation throughout California and the Great Basin (Arnold 1992; Arnold and Munns 1994; Bennyhoff and Hughes 1987; Eerkens et al. 2005; Graesch 2004; Hartzell 1991; Hughes and Milliken 2007). Craft specialization – or the organized and standardized production of goods and services “well beyond local or personal needs” (Arnold and Munns 1994:475) – is further evidenced on-site by thousands of flaked stone tools, a cache of 41 oversize bifaces and other lithic production features, and voluminous debris associated with the manufacture and trade of leaf-shaped bifaces (Schneider et al. 2013). These impressive bifaces were made from top quality Napa obsidian that was quarried less than one mile distant (Carpenter and Mikkelsen 2005; Wohlgemuth et al. 2004). Given the specialized production of obsidian bifaces at CA-NAP-399 and considering the site's connection to a wider network of craft specialization involving the manufacture and distribution of *Olivella* shell beads, we consider whether other forms of craft production that were not necessarily “specialized” were carried out by select groups of skilled craftspeople.

We believe that a collection of steatite disk beads from CA-NAP-399 reveals clues to understanding craft production carried out by a wider cross-section of society that includes more than specialists. Three distinct contexts characterize the steatite disk beads from CA-NAP-399: two burials (one adult male and one adult female) and one isolated find. We employ RTI and a variety of visualization rendering modes to examine surface details of 29 steatite disk beads from the larger of the two burial bead lots. The goal is to better explore the relationship between bead

¹ Date ranges for the central California chronological sequence, or Central California Taxonomic System, and AMS radiocarbon dates are uncalibrated, unless indicated by “cal BP.” See Schneider et al. (2014a, 2014b) for a complete list and discussion of AMS radiocarbon assays for CA-NAP-399.

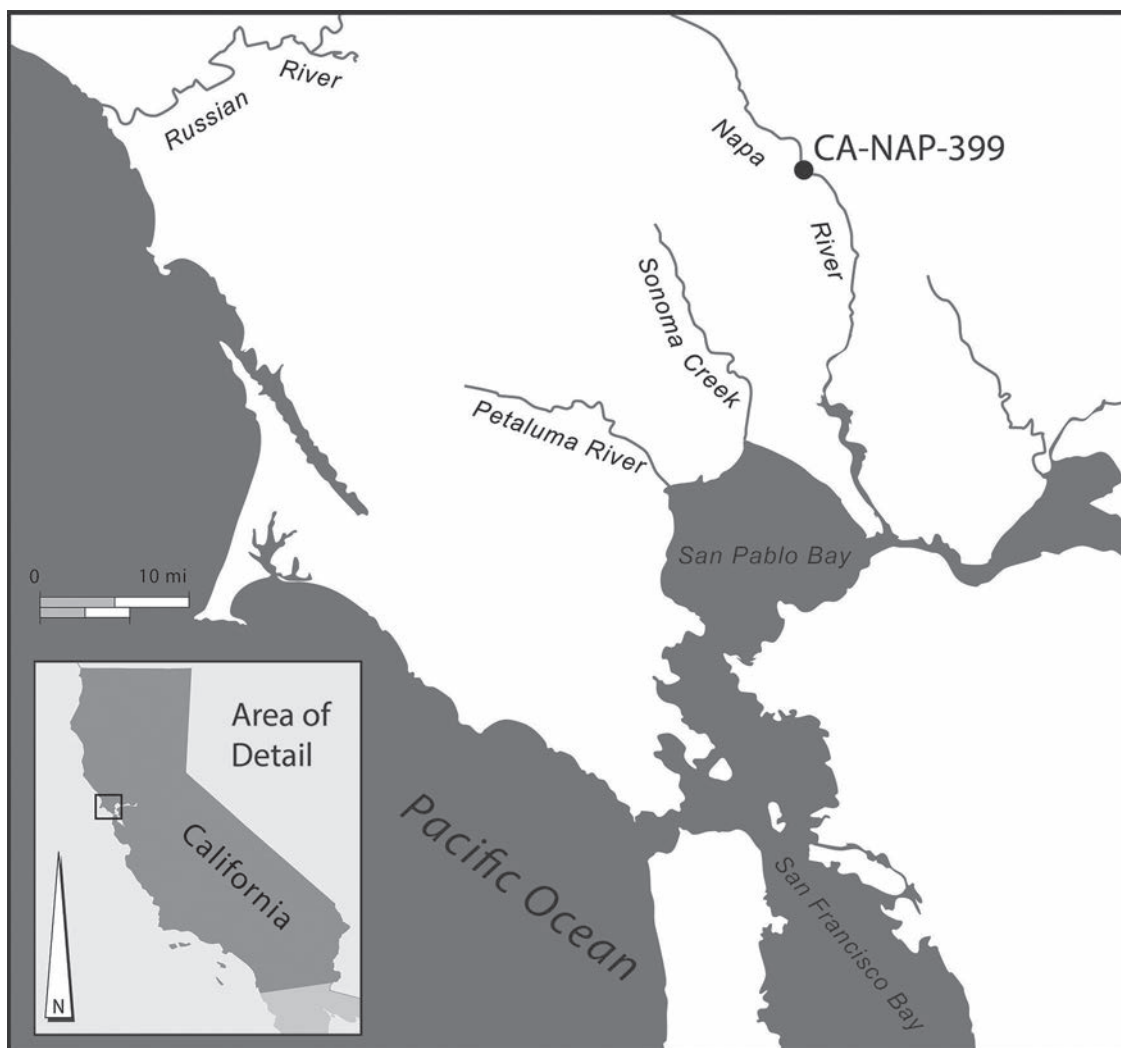


Figure 11.3 Location of CA-NAP-399 in the Napa Valley of California (illustration by Tsim Schneider).

manufacture and the bead-makers who created them. Using quantitative and qualitative data collected on the beads, we ultimately address whether dissimilarities between all three steatite bead contexts, including differences in bead sizes and manufacturing attributes, could reflect unique manufacturing techniques compared to the other more structured forms of craft production evidenced onsite.

Project Background and Site Description

Robert F. Heizer directed the earliest archaeological investigations in the Napa Valley under the auspices of the University of California Archaeological Survey (Heizer 1953). As part of this effort, several sites in the Napa Valley and vicinity were excavated to establish baseline cultural and temporal frameworks for the region and to understand the broader prehistoric and historical developments in central California (Heizer 1953). Since that time, the local

chronology continues to be retooled owing to mounting archaeological data and advances particularly in obsidian hydration dating (e.g. Martin and Meyer 2005; Origer 1982, 1987; Rosenthal 2005). Pertinent overviews of the archaeology and ethnohistory of the Napa region and the southern North Coast Ranges are provided by Bennyhoff (1994a [1977]), Driver (1936), Fredrickson (1973, 1974), Heizer (1953), Hildebrandt (2007), and Milliken et al. (2007). Whereas marine shell, bone, glass and sometimes even stone beads are featured in many descriptions of Napa artifact assemblages, few researchers have taken steatite beads as a discrete focus of study. The discovery of steatite disk beads at CA-NAP-399 provided a unique opportunity to examine the stone beads within a well-defined archaeological context.

Damages to the City of St. Helena (California) from severe flooding of the Napa River in 1986 and 1995 prompted the development of improved flood control measures,

including channel and floodplain reconfigurations, floodwall construction, mobile home relocation, and revegetation efforts along the Napa River less than two kilometers east of St. Helena. Archaeological survey, testing, and data recovery were conducted to mitigate potential damage to cultural resources during construction (Bartoy and Holson 2005, 2007; Bartoy et al. 2005). Under the direction of John Holson of Pacific Legacy, Inc. (Berkeley, California) data recovery excavations, a geoarchaeological study, and construction monitoring took place within the CA-NAP-399 Area of Potential Effect, which measured approximately 240×40 m. From 2007 to 2010, portions of three additional sites, CA-NAP-406, CA-NAP-413 and CA-NAP-863, were also excavated as part of the same data recovery effort (Schneider et al. 2013), though none to the extent of CA-NAP-399.

The site's close proximity to Napa Glass Mountain, a well-known source of top quality obsidian in the region (Jackson 1986), is reflected in the enormous assemblage and high density of flaked stone tools and debitage, including over 250,000 pieces of lithic debitage, 1475 leaf-shaped bifaces, 59 projectile points, and other flake tools, as well as multiple lithic reduction loci and a cache of 41 nearly uniformly sized obsidian bifaces. Other artifacts collected from CA-NAP-399 include ground stone implements, charmstones (or plummets), modified bone, faunal remains, abalone (*Haliotis* sp.) ornaments, and quartz crystals. Beads collected from CA-NAP-399 included steatite disk beads (discussed below), tubular bone beads ($n = 19$) and bead starts ($n = 13$) made predominantly from small bird bones with only one mammal bone bead, 251 glass beads associated with one historic human burial, and 136 *Olivella* shell beads representing 15 temporally diagnostic bead types following the typology and identification conventions presented in Milliken (2009; Schneider et al. 2013, 2014b).

In addition to the large and diverse artifact assemblage from CA-NAP-399, a total of 163 human interments, including four secondary cremations, were excavated and analyzed in close cooperation with representatives of the Mishewal Wappo Tribe of Alexander Valley (Mishewal Wappo). With approval from the Mishewal Wappo, AMS radiocarbon dates were derived from 22 bone collagen samples (21 determinations from human bone, one from animal bone) and confirm a late Middle Archaic to Upper Archaic component (2450 to 1950 BP) of the central California chronological sequence (Schneider et al. 2013, 2014a). The radiocarbon samples were selected at random from burials at various depths and spatial locations around the site. One historical outlier was confirmed by a conventional AMS date of 150 ± 30 BP (cal BP 280–170, 160–60, 40–0, and 0–post 1950; 2 sigma) from a young adult woman associated with 251 glass beads. Except for this individual, all of the AMS dates – and, arguably, the entire cemetery – fall within a 500-year time frame ranging from approximately 2450 to 1950 BP. In

addition, a later Augustine Pattern assemblage (ca. 1050 to 650 BP) without a mortuary component is signaled on-site by several small serrated and corner-notched projectile points. The 500-year span for the cemetery represents approximately 15 to 20 generations – a clear and powerful example of human attachment to a specific locale, as well as demonstrating long-term social memory of the site as a place of death, interment and mourning, and a space where funerary activities linked ancestors to descendants (Schneider et al. 2014b).

Steatite Artifacts in California Archaeology and Ethnography

From northwest California to the shellmounds of the San Francisco Bay, from the Sierra Nevada to the Sierra Pelona, and from the Southern Bight to the Channel Islands, archaeological and ethnographic sources reveal that California's indigenous populations transformed steatite into beads, charmstones, pipes, arrow shaft straighteners, vessels, effigies and other objects for exchange, marking social status, feasting and day-to-day activities (e.g. Gamble 2008:184; Gamble and Russell 2002:117; Gifford and Schenck 1926:66-77; Heizer and Treganza 1971 [1944]; Rhode 1996; Rosenthal and Williams 1992; Uhle 1907; Weigel 1988; Wlodarski 1979). Steatite is a soft material (Mohs hardness scale of 3.0) compared to *Olivella* shell (Mohs hardness scale of 5.0–5.5) (Arnold 2012:282). It has been estimated that two hours were required to produce a steatite charmstone (Wlodarski 1979:342; see also Treganza and Valdivia 1955), and that other “precision-oriented” objects such as steatite beads might have taken longer to create. Assuming multiple beads were created in one location, the archaeological residues of multiple-hour steatite bead manufacturing sessions – including dust, chips and other debris – should give bead scholars pause to consider them in their future work.

At least one ethnographic account of the Yokuts of the southern Sierra Nevada region describes the steatite bead-making process and a partial toolkit (Driver 1937). Accordingly, a steatite cylinder (“pencil”) was held in a “doughnut” stone vise for cutting and, periodically, a perforated section of the cylinder was snapped off and the rough surface was ground smooth (Driver 1937:125). Excavating a site adjacent to a steatite quarry in the Sierra Nevada foothills, Weigel (1988:268) recorded – and confirmed through casual experimentation – a discrete steatite dust layer attributed to the abrading, shaping and polishing of steatite chunks into artifacts. The location of CA-NAP-399 near the sandy banks of the Napa River could have facilitated the grinding and polishing of beads since sand and water are effective abrasives. In a relevant example from coastal Georgia, Francis (2009:117) notes that stone beads could be polished either by rubbing them against a

hard stone, or placing the beads into a leather bag with water and an abrasive like rock, dust or sand, then rolling the bag back and forth.

In California, Wlodarski (1979) devised a “soapstone manufacturing continuum” comprised of three orderly stages of steatite artifact manufacture and associated manufacture markings (Tab.11.1). Though more of a heuristic device, Wlodarski’s (1979) continuum and the examples listed above are useful for considering not just the tools, markings and even residues of steatite bead manufacture, but they also attract further consideration of the people or “communities of practice” (Lave and Wenger 1991) potentially involved at various steps along the stone bead manufacturing trajectory. Learning develops and is reinforced through social interactions within a community, and the process of imparting knowledge is not necessarily the express domain of craft specialists. We openly consider the myriad learning styles and experiences that are brought to bear in the creation and innovations witnessed in material culture (e.g. Sassaman and Rudolphi 2001). In a similar way, Arnold (2012) observes that even with extensive assemblages of *Olivella* shell beads and bead manufacturing detritus from the Channel Islands, archaeologists can do more to illuminate the age, sex, status and other identifiers of bead-makers. Moreover, questions remain about how bead-making practices were learned and how techniques were either retooled or embodied by apprentices and specialized practitioners alike.

Perhaps because steatite beads are not directly dateable or because fewer examples exist, those appearing in the Napa region and in central California more broadly reflect a sense of temporal obscurity. For example, Gifford and Schenck (1926:77) attributed steatite artifacts in the southern San Joaquin Valley to Chumash fleeing Spanish missionary activity on the coast, an observation apparently supported

by numerous surface finds and at least one specimen with an incised cross (Gifford and Schenck 1926:71). Heizer (1953:318) and co-workers were ambiguous in assigning a date to at least four steatite disk beads from CA-NAP-32 that were “both early and late” in age. Steatite beads feature prominently in many Augustine Pattern artifact assemblages from the Napa region (dating from 1050 to 650 BP: Bennyhoff 1994a [1977], 1994b [1982]; Elsasser 1978:40–41). In fact, following Beardsley (1954:44), many typologists simply assigned steatite beads and other high-precision technologies to later prehistoric times, or after approximately 450 BP when they were thought to be “invariably associated” with the sophisticated manufacture and exchange of clamshell disk beads. In another effort to track steatite bead developments through time and space, Bennyhoff and Fredrickson (1967) established a steatite bead typology organized around five steatite bead classes – Class A (disk), Class B (ring), Class C (cylindrical), Class D (hourglass) and Class E (flanged) beads – and subtypes distinguished primarily by differences in bead size within each class. While providing a useful analytic scaffolding, the typology is incomplete and little has been done to revise or update it since its creation in the late 1960s. Even more recently, archaeologists continue to observe steatite beads in a range of temporal contexts. For example, Origer (1994:24) suggests the temporal placement of steatite beads is insecure as they are associated with both early and late occupations in the Napa Valley.

Steatite Beads and Artifacts from CA-NAP-399

Remarkably few (n = 23) of the 163 human burials from CA-NAP-399 contained shell, bone, stone or glass bead

Table 11.1. Stages of steatite artifact manufacture (after Wlodarski 1979:fig. 16).

<i>Manufacture stage</i>	<i>Description</i>	<i>Manufacture markings</i>
1	Quarry, gouge, dig	Visible deep grooves, cuts, incisions and gouge marks on the surface.
2	Crumble, scrape, peck, fracture	Many visible shallow thick to thin cuts, lines and striations on surface. Some deep grooves remain.
3a	Grind, smooth, drill, incise, inlay, perforate	Most visible deep cuts and shallow lines are worked out. Smoother texture exhibited.
3b	Finish polish	Surface exhibits sheen and visible luster.

Table 11.2. Summary of beads directly associated with burials and AMS radiocarbon ages.

<i>Bead material</i>	<i>Burial number</i>	<i>Bead count</i>	<i>Description</i>	<i>AMS radiocarbon age</i>
Bone	84	24	Tubular beads and bead starts	N/A
Glass	32	251	Glass trade beads	150 ± 30 BP (1σ)
Shell	73	60	<i>Olivella</i> beads	2050 ± 30 BP (2σ), 2100 ± 30 BP (2σ)
	79	14	<i>Olivella</i> beads	2090 ± 30 BP (2σ)
	138	1	<i>Olivella</i> bead	N/A
	141	30	<i>Olivella</i> beads	N/A
Steatite	25	11	Disk beads	N/A
	117	29	Disk beads	2140 ± 30 BP (2σ)

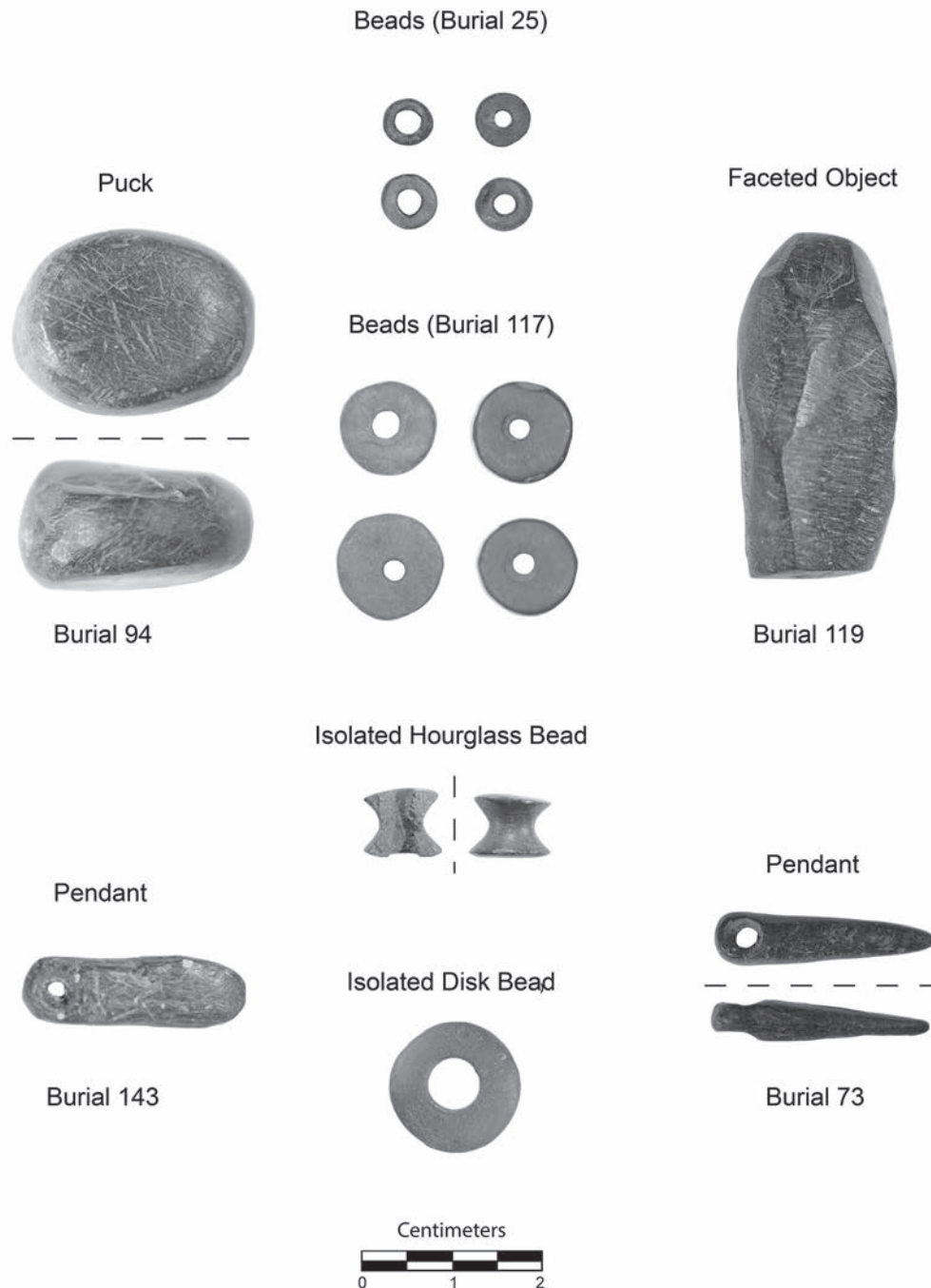


Figure 11.4 Steatite artifacts from CA-NAP-399 (photo by Tsim Schneider).

furnishings. Of these, only eight burials (Burials 25, 32, 73, 79, 84, 117, 138 and 141) had confident direct bead associations (Tab. 11.2), whereas an additional 15 interments had beads in the surrounding burial matrix. Interestingly, burials with directly associated beads contained only one bead material type. That is, even excluding the historic burial with glass beads, prehistoric burials at CA-NAP-399 contained marine shell beads, bone beads or steatite beads, but never mixtures of more than one bead material type.

Steatite disk beads were found in association with Burial 25 and Burial 117 (Fig. 11.4; Tab. 11.3), the only two individuals discovered with stone beads. Burial 25, an adult male of 30 to 40 years, robust and strongly muscled but with poor dental health and evidence of anemia, was interred with 11 complete steatite disk, or “ring”, beads measuring 4.5 mm to 6.2 mm. Burial 117 was an older adult female who suffered from a serious bone infection, degenerative joint disease and poor oral health, yet she

Table 11.3. Summary of steatite beads from CA-NAP-399 (Schneider et al. 2013).

Unit/ burial no.	Length (mm)	Width (mm)	Thick. (mm)	Dia. (mm)	Perforation dia. (mm)	Perforation shape	Description	Profile*
RRU-3	7.4	8.4	4.8	-	2.6	Biconical	Hourglass bead; split vertically	-
RRU-3	-	-	2.9	14.4	5.4	Biconical	Disk bead	BX
Burial 25	-	-	1.1	6.2	1.7	Cylindrical	Disk bead	BX
Burial 25	-	-	1.2	5.5	2.1	Biconical	Disk bead	ABX
Burial 25	-	-	0.9	5.1	2.2	Conical	Disk bead	ABX
Burial 25	-	-	0.9	4.5	2.0	Biconical	Disk bead; semi- ground edge	ABX
Burial 25	-	-	1.1	5.8	3.1	Biconical	Disk bead	BX
Burial 25	-	-	1.0	5.8	2.4	Biconical	Disk bead	BX
Burial 25	-	-	1.3	5.8	2.0	Biconical	Disk bead	PX
Burial 25	-	-	1.0	5.5	2.4	Biconical	Disk bead	BX
Burial 25	-	-	1.1	6.1	2.2	Biconical	Disk bead	BX
Burial 25	-	-	1.0	6.1	2.3	Biconical	Disk bead	BX
Burial 25	-	-	1.0	6.2	1.7	Biconical	Disk bead	PX
Burial 117	-	-	1.8	11.2	2.0	Biconical	Disk bead; faceted ventral surface; polished	ABX
Burial 117	-	-	1.3	11.7	2.1	Biconical	Disk bead; faceted ventral surface; polished	ABX
Burial 117	-	-	1.5	12.2	2.3	Biconical	Disk bead; faceted ventral edge; polished	ABX
Burial 117	-	-	1.7	11.3	2.1	Biconical	Disk bead; faceted ventral edge; polished	ABX
Burial 117	-	-	1.5	11.9	2.5	Biconical	Disk bead; faceted ventral edge; polished	ABX
Burial 117	-	-	1.6	12.4	2.4	Biconical	Disk bead; faceted ventral edge; polished	ABX
Burial 117	-	-	1.7	11.6	2.2	Biconical	Disk bead; faceted ventral edge; polished	ABX
Burial 117	-	-	2.0	11.6	2.0	Biconical	Disk bead; faceted ventral edge; polished	ABX
Burial 117	-	-	1.8	13.0	2.0	Biconical	Disk bead; rough finish	BP
Burial 117	-	-	1.8	11.7	2.7	Biconical	Disk bead; faceted edge; rough finish	BP
Burial 117	-	-	1.7	12.0	2.2	Biconical	Disk bead; faceted edge; rough finish	Tapered

(Continued)

Table 11.3. Summary of steatite beads from CA-NAP-399 (Schneider et al. 2013). (Continued)

Unit/ burial no.	Length (mm)	Width (mm)	Thick. (mm)	Dia. (mm)	Perforation dia. (mm)	Perforation shape	Description	Profile*
Burial 117	-	-	1.4	11.6	2.1	Biconical	Disk bead; rough finish; perforation off-center	Tapered
Burial 117	-	-	2.1	11.2	2.9	Biconical	Disk bead; faceted edge; rough finish	BP
Burial 117	-	-	1.4	11.8	2.7	Conical	Disk bead; faceted edge; rough finish	Tapered
Burial 117	-	-	1.6	12.3	2.4	Biconical	Disk bead; faceted edge; rough finish	BP
Burial 117	-	-	1.8	11.8	2.9	Biconical	Disk bead; faceted edge; rough finish	BP
Burial 117	-	-	2.1	11.9	2.0	Biconical	Disk bead; rough finish	Tapered
Burial 117	-	-	1.5	12.0	1.7	Biconical	Disk bead; rough finish	BP
Burial 117	-	-	1.7	11.8	3.0	Biconical	Disk bead; rough finish	BP
Burial 117	-	-	2.0	11.9	2.6	Biconical	Disk bead; faceted edge; rough finish	BP
Burial 117	-	-	1.8	11.4	2.0	Biconical	Disk bead; rough finish; perforation off-center	BP
Burial 117	-	-	2.0	11.1	2.9	Biconical	Disk bead; faceted edge; rough finish	BP
Burial 117	-	-	1.6	11.4	2.1	Biconical	Disk bead; polished; chipped	Tapered
Burial 117	-	-	1.9	10.8	2.9	Biconical	Disk bead; rough finish	BP
Burial 117	-	-	1.5	11.6	2.2	Biconical	Disk bead; rough finish; chipped	BP
Burial 117	-	-	1.6	11.9	2.7	Biconical	Disk bead; rough finish; chipped; perforation off-center	BP
Burial 117	-	-	1.8	11.1	2.6	Cylindrical	Disk bead; polished; chipped	Tapered
Burial 117	-	-	2.0	11.0	3.0	Biconical	Disk bead; rough finish	BP
Burial 117	-	-	1.6	10.6	3.0	Cylindrical	Disk bead; rough finish	BP

*BX = biconvex; ABX = asymmetrically biconvex; PX = plano-convex; BP = biplano

survived into her 50s. The older woman was buried with 29 complete steatite disk beads that had been placed under her head. Bone collagen from the skeleton of this woman produced a measured AMS date of 2140 ± 30 BP, or cal BP 2340–2290 and 2270–2150 (2 sigma) (Schneider et al. 2014a). The 29 steatite beads placed with Burial 117 at her death measure between 1.7 mm and 3.0 mm and are the focus of our RTI project.

Two steatite beads were also collected as isolated finds from an excavation unit (RRU-3), including one steatite disk bead and one biconically drilled “hourglass” bead fragment (Fig. 11.4). Spatially, RRU-3 is approximately equidistant between Burial 25 (ca. 16 m east of RRU-3) and Burial 117 (ca. 20 m northwest of RRU-3). The isolated disk bead was found 100–120 cm below the surface. The isolated hourglass bead is split in half vertically and was collected from the upper 40 cm of the CA-NAP-399 deposit. Less than one kilometer to the southeast of CA-NAP-399, Beard and Origer (1995:42) collected two steatite hourglass beads from CA-NAP-159 that they assigned to the late Emergent Period, or 1050 to 150 BP (see also Bennyhoff and Fredrickson 1967; Heizer 1953:286). Unlike CA-NAP-399, only one steatite disk bead and 93 hourglass-shaped steatite beads were tallied during investigations at CA-NAP-1 (Heizer 1953:257). Indeed, a reversal of this pattern upriver at CA-NAP-399, where only one hourglass bead and 40 steatite disk beads were recovered, is intriguing and could reflect differential access to beads or different bead workshops along the Napa River. Steatite hourglass beads are reported at several other Napa Valley sites, including CA-NAP-57 where 149 specimens were documented (Heizer 1953; see also Beard 1991). Outside the Napa Valley, Schenck and Dawson (1929:382) reported steatite disk, ring and hourglass beads from several inland San Joaquin Valley sites, including one site that produced a bracelet discovered *in situ* with hourglass beads alternately strung with clamshell beads.

Additional steatite artifacts collected from CA-NAP-399 burials include two pendants with drilled ends and ground or rounded edges, one faceted chunk and one unperforated disk or “puck” (Fig. 11.4). The steatite puck was indirectly associated with Burial 94 and this artifact type is often referred to as a labret, ear spool or ear plug (e.g. Heizer 1953:259; Nelson 1910:390). Used as items of bodily adornment, 10 “ear plugs” were reported at CA-NAP-1 (Heizer 1953:259). The steatite chunk exhibits multiple longitudinal facets (or, surfaces), macroscopic abrasions from the grinding process, and its distal end is ground flat. One oblong steatite pendant was collected in direct association with Burial 143, and a perforation at one end suggests it was strung for use as a pendant, possibly with other beads and ornaments. A second steatite pendant was discovered in direct association with Burial 73; its shape is triangulate and it too has a perforation on one end.

Oblong and triangulate stone pendants have been observed in other Bay Area contexts (e.g. Nelson 1910:427). Four steatite pendant fragments were also collected nearby at CA-NAP-159 and appear to be similar in shape and size to the two complete pendants collected from CA-NAP-399 (Beard and Origer 1995:35).

Methods and Analysis

The analysis of all steatite beads from CA-NAP-399 first involved the collection of metrical attributes, including length, width, thickness, diameter and perforation diameter measurements using digital calipers (Tab. 11.3). Macrotopographic observations and RTI were then used to gather important qualitative data, including bead coloration, condition, perforation type, profile shape, as well as surface modifications resulting from abrasive wear. Owing to the scheduled reburial of all human remains and associated artifacts, RTI analysis was limited to the 29 steatite beads associated with Burial 117.

Following the terminological conventions of Adams (2014), who argues for the use of standardized concepts in ground stone use-wear analysis, “abrasion” on the bead surfaces collectively references both deep “gouges” and shallower “scratches” resulting from the reductive processes of creating and using ground stone objects. To this end, we observed that RTI heightened our ability to detect grinding and polishing, especially edge grinding; for some beads, the grinding technique used to craft a circular bead form resulted in flattened areas (i.e. facets) between the edge and faces of the bead. We interpret these facets as representative of an earlier phase of bead manufacture leading toward more finished beads exhibiting uniformly ground edges and polished surfaces. In the analysis that follows, RTI was thus geared toward facilitating the identification of potentially unique manufacturing characteristics and the sequence of manufacturing events. Mixtures of beads with and without facets, non-uniform patterns of abrasive wear, various perforation types, color differences and a variety of other attributes observed within just one lot of 29 beads from a single burial context we believe represents manufacturing preferences and techniques carried out by different bead makers.

Bead Color

Examining the colors of steatite disk beads, 20 of the 29 beads from Burial 117 were light grayish-blue and nine were grayish-blue (Fig. 11.5). The isolated bead is light grayish-blue and the steatite beads from Burial 25 are mostly light grayish-blue, except for one semi-translucent tan bead. Color distinctions may relate to different steatite quarries generating fine and coarse-grained material (e.g., Wlodarski 1979; see also Gifford and Schenck 1926:66), or



Figure 11.5 Steatite beads from Burial 117, CA-NAP-399. Note scale and color variation (photo by Lori Hager).

even variation within the same steatite core used to create the beads. While the assemblage from CA-NAP-399 is now reburied and removed from further inquiry, future researchers examining steatite beads from other archaeological sites might also employ petrographic analysis to help discriminate variation in steatite coarseness potentially linked to specific quarries across the landscape.

Bead Profile and Perforation Type

Steatite disk bead profiles are described as biconvex, asymmetrically biconvex, plano-convex, biplano, or tapered (Tab.11.4). Accordingly, the isolated disk bead has a biconvex profile; the disk beads from Burial 25 are biconvex ($n = 6$), asymmetrically biconvex ($n = 3$) and plano-convex ($n = 2$), and the beads from Burial 117 are asymmetrically biconvex ($n = 8$), biplano ($n = 15$) and tapered ($n = 6$). Most steatite beads ($n = 36$) are biconically drilled (i.e. drilled from two directions). Biconically drilled beads likely correlate with the type of drill being used combined with a well-developed strategy to avoid breaking the bead blank or the drill. There are, however, specimens within the burial bead lots that exhibit cylindrical ($n = 3$) and conical ($n = 2$) perforations (Tab. 11.4),

which may reflect experimentation, different bead-makers, or – as observed by Wlodarski (1979:333) in his study of the Santa Catalina Island soapstone industry – even differences in the coarseness of the stone used to produce the beads.

Table 11.4. Summary of steatite bead profiles and perforation types.

<i>Profile type</i>	<i>Burial 117</i>	<i>Burial 25</i>	<i>Isolated bead</i>	<i>Total</i>
BX	0	6	1	7
ABX	8	3	0	11
PX	0	2	0	2
BP	15	0	0	15
Tapered	6	0	0	6
<i>Perforation type</i>				
Biconical	26	9	1	36
Cylindrical	2	1	0	3
Conical	1	1	0	2

*BX = biconvex; ABX = asymmetrically biconvex;
PX = plano-convex; BP = biplano

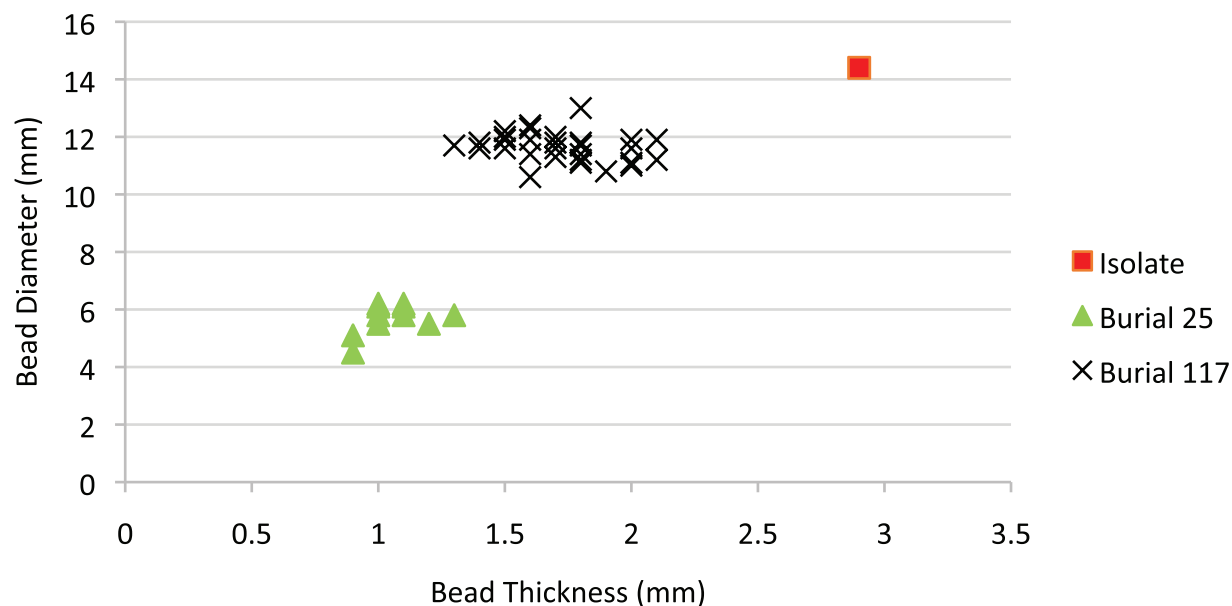


Figure 11.6 Bivariate plot of steatite bead thickness by diameter showing clustering by bead lot

Bead Size

Considering the paucity of steatite beads from CA-NAP-399, clustering of stone beads by size is especially revealing (Fig. 11.6). Bead diameters from Burial 25 range from 4.5 mm to 6.2 mm, whereas the isolated bead has a diameter of 14.4 mm and bead diameters from Burial 117 range from

10.6 mm to 13 mm. Even these relatively basic attributes (i.e. bead color, size clusters, profile and drilling) showcase variability within each bead lot, as well as differences between steatite bead lots. Wlodarski (1979:342) too noted “enormous” variability in soapstone artifact types from Santa Catalina Island. Compared to the more formalized



Figure 11.7 Diffuse gain rendering mode of steatite beads (unscaled composite; see Fig. 11.5 for scale) (photo by Lori Hager).

and uniform production of shell beads typically ascribed to craft specialists, steatite bead production appears to adhere to less rigid, arguably more individualized, or innovative (Arnold 2012), manufacturing trajectories.

RTI: Diffuse Gain

Diffuse gain enhances the perception of surface shape features that have sudden changes in heights and depths (CHI 2010). For beads, diffuse gain is well suited for edge contrast at the bead perimeter and at the edge of the perforation (Fig. 11.7). In addition, moving the light across the bead perforation allows for a 3-D view of the beads' inner wall, giving critical information on the drilling process. Abrasion on the surfaces of some beads is easily recognizable when the light position moves across the images in the RTI Viewer.

Based on the RTI images of the CA-NAP-399 steatite beads, approximately half of the beads have abrasion on their obverse (48%) and reverse (45%) sides, whereas most beads have very little surface scratching. This suggests varying levels of polishing or "finishing" within this bead lot, or simply that some stone is less prone to scratching than others. The diffuse gain mode also confirmed our previous visual observations that 79% of the steatite beads had been biconically drilled, followed by fewer examples of cylindrical and conical perforations. Although drill markings on the inside walls of the perforation were not recognizable (see van Gijn 2006), the RTI technique was particularly useful in distinguishing between the conical and biconical drilling where the secondary drilling shelf was barely visible. Compared to harder marine shell, factors such as stone density and pliability, irregularities within the stone, and bead thickness – as well as differences in the experience of the bead-makers – might account for slight differences seen in bead boring methods. Alternatively, compared to other bead attributes such as color, size and grinding method – conceivably, more personalized choices – a biconical perforation can also reflect a more routine choice for steatite beads and be applied more as a practical means to prevent breakage (see also Francis 2009:116).

RTI: Specular Enhancement

Different materials have different degrees of specular reflection. For example, glassy obsidian has a different specular reflection (i.e. shiny) compared to porous ground stone (i.e. matte). Specular enhancement increases the perception of surface shapes using an algorithm that considers diffuse RGB color, specular reflection based on surface shape, and the size of the specular highlights (CHI 2010). Use-wear – including reductive processes attributable to fatigue (e.g. cracks, step fractures and pits) and abrasion (e.g. scratches, gouges and flattened areas at margins of

obverse and/or reverse sides of a bead) – stands out in this rendering mode, giving clues to bead manufacture and the manufacturers (Fig. 11.8).

Seventeen beads in the Burial 117 lot were found to have distinct grinding signatures resulting in unifacial facets (i.e. flattened areas along the margin of one side only) and twelve beads have bifacial facets (i.e. flattened areas along the margins of both sides), further implying no formalized grinding technique. Only four steatite beads lacked these flattened areas altogether, suggesting a later stage of polishing. Chipping was observed with clarity through specular enhancement on the majority of the beads ($n = 20$) although we are unable to distinguish purposeful chipping associated with an early stage of bead blank manufacture from chipping that occurred post-depositionally. Other attributes distinguished in this rendering mode such as the presence of surface irregularities (e.g. banding and inclusions) may have more to do with the raw material used for the beads and rock asperity, or "a combination of rock granularity and surface texture... influenced by rock durability" (Adams 2014:130). For example, we noted irregularities on the surfaces of eight beads, including some with more durable projections visible on their surfaces. On the other hand, rather than assuming that bead-makers would remove such idiosyncratic attributes from their beads through additional grinding, we wonder if these features were purposefully retained? That only a few beads within this bead lot have surface irregularities, we believe, has more to do with production by a variety of bead-makers than simply the heterogeneous nature of the stone.

RTI: Luminance Unsharp Masking

A sharpening mode that applies a blurred positive image, or "unsharp mask," to a photograph can enhance the original image and amplify changes in depth and color (CHI 2010). Unsharp masking in the RTI Viewer combines surface normal data (or the 3-D data) and color data. For the steatite beads, luminance unsharp masking was used to enhance our view of the edges, perforations and surface abrasions without affecting color.

Scratches on the surface of the beads are amplified using RTI and we were surprised to observe a mixture of grinding techniques, including abrasions with one or two gouges, multiple cross-hatched scratches, or more frenetic, multi-directional abrasions (Fig. 11.9). With the expectation that specialists would adopt and practice a single time and materials-sensitive grinding technique, this variation suggests an array of grinding methods were applied to this single set of 29 beads. Furthermore, the RTI demonstrated that the light gray beads were more heavily abraded than the blue ones and that in many but not in all instances, the scratches preceded the drilling of the perforation, thus shedding light on the production trajectory (i.e. grinding before drilling). The

luminance unsharp masking mode also revealed that some scratches extended onto the ground facets of some beads, further suggesting that additional grinding and/or polishing took place after perforation and that stages of steatite disk bead manufacture were non-uniform, or individualistic.

Discussion

Reconsideration of steatite beads in everyday life, as well as the “itineraries” along which beads are made, taken, gifted, handled, shaped, adorned, rejuvenated, lost, buried and broken by people from different segments of society (Joyce 2012:124), suggests the Napa Valley beads were more than showpieces for adornment in life and in death. We contend that size clustering and unique bead manufacturing attributes illuminated by the RTI technique and various visualization rendering modes speak to broad social contexts for steatite beads that cannot be explained solely by differences in social status, which is usually inferred by differences in burial placement, positioning, or grave furnishings, or by craft production and specialization.

Although steatite disk beads have been found in many regions of California, in central California and the Napa region they tend to be marginalized as late arrivals, or simply viewed as “corollaries of the clam disc bead trade” that occurred during the 500 years before European colonization (Beardsley 1954:60). Given the large-scale excavations at CA-NAP-399, we are confident that clamshell beads are absent despite the presence of steatite disk beads. Our assay of 22 AMS radiocarbon dates, including dates from burials bearing steatite artifacts, further confirms a distinct 500-year span during the Upper Archaic, or approximately 2450 to 1950 BP (Schneider et al. 2014a), supporting a deeper time frame for production of steatite disk beads in California than previously thought.

In addition to rethinking their temporal marginalization, considerable ambiguity also surrounds the manufacture and role of steatite beads in California prehistory, particularly compared to elevated scholarly attention given to marine shell beads. Productive dialogues on craft specialization and social complexity that focus on the pivotal role of shell beads as media of exchange and diagnostic markers of social status among California hunter-gatherers have been put forward (e.g. Arnold 1992, 2004; Arnold and Graesch 2001; Arnold and Munns 1994; Bennyhoff and Hughes 1987; Gamble 2008:229–234; Graesch 2004; Groza et al. 2011; King 1976). *Olivella* shell beads are known especially as hallmarks of bead “industries” supported by craftspeople that specialized in the production of many thousands of small marine shell beads over many centuries to be amassed by elites as important status symbols and/or distributed within local and far-flung exchange networks extending inland several thousand miles. In comparison, we think the modest collection of 41 steatite beads from the

Napa Valley site details community-wide craft production that can be juxtaposed with other examples of outright craft specialization, even at the same site. In light of the elaborate obsidian biface industry discovered at the site and the presence of highly prized *Olivella* beads with some burials, craft specialization by the people at CA-NAP-399 was likely (e.g. Carpenter and Mikkelsen 2005; Wohlgemuth et al. 2004). By contrast, we suggest that the variability within and between the steatite bead lots clearly differs from the greater uniformity witnessed in *Olivella* shell bead types and the near-boilerplate production of leaf-shaped obsidian bifaces at CA-NAP-399 (Fig. 11.10).

Most striking, the disk beads cluster by size, making them unique to the contexts in which they were found. Different bead colors (i.e. grayish-blue, light grayish-blue and semi-translucent tan) also speak to distinctions in the steatite core used to manufacture the beads and/or differences in the various steatite quarries and the coarseness of the raw material (Wlodarski 1979). These differences in coloration could also be attributable to different preferences – symbolic, economic or otherwise – of the bead-makers or the bead acquirers (e.g. Bar-Yosef Mayer and Porat 2008), as well as to the distribution or acquisition of beads piecemeal or in smaller batches. Tapered, flattened, semi-flattened and rounded bead profiles we take as evidence of unique grinding techniques that did not always result in uniform bead shapes. Perforations were created in most beads by drilling from both sides of the bead (i.e. biconical); fewer specimens have conical and cylindrical bores, although we must also consider the practice of redrilling in which biconical perforations transformed into cylindrical ones. Compared to variations in bead color, grinding/shaping and bead size that suggest individuality, biconical drilling may have been a more widely acknowledged method to protect investments of time and material. Excepting perforation type, these visual attributes are insightful for understanding, not only variation in bead manufacturing preferences, but also non-standardized techniques potentially carried out by a wide cross section of society, including specialized bead-makers and novices, for reasons other than political and economic gain. We turned to RTI to draw out and better understand these distinctions.

Our RTI study focused on 29 steatite beads from one human burial. Diffuse gain, specular enhancement and luminance unsharp masking rendering modes were employed to target different portions of the beads for study (CHI 2010, 2013c). The diffuse gain rendering mode was employed to detail surface abrasions resulting from bead grinding and polishing, as well as attributes of the perforation giving an indication of the drilling process. Surface abrasions were nearly equally split between those with a heavy degree of surface scratching and beads with fewer striations, which is taken to mean that not all of the beads were at the same level of completion before being deposited. Specular enhancement proved especially useful for identifying facets

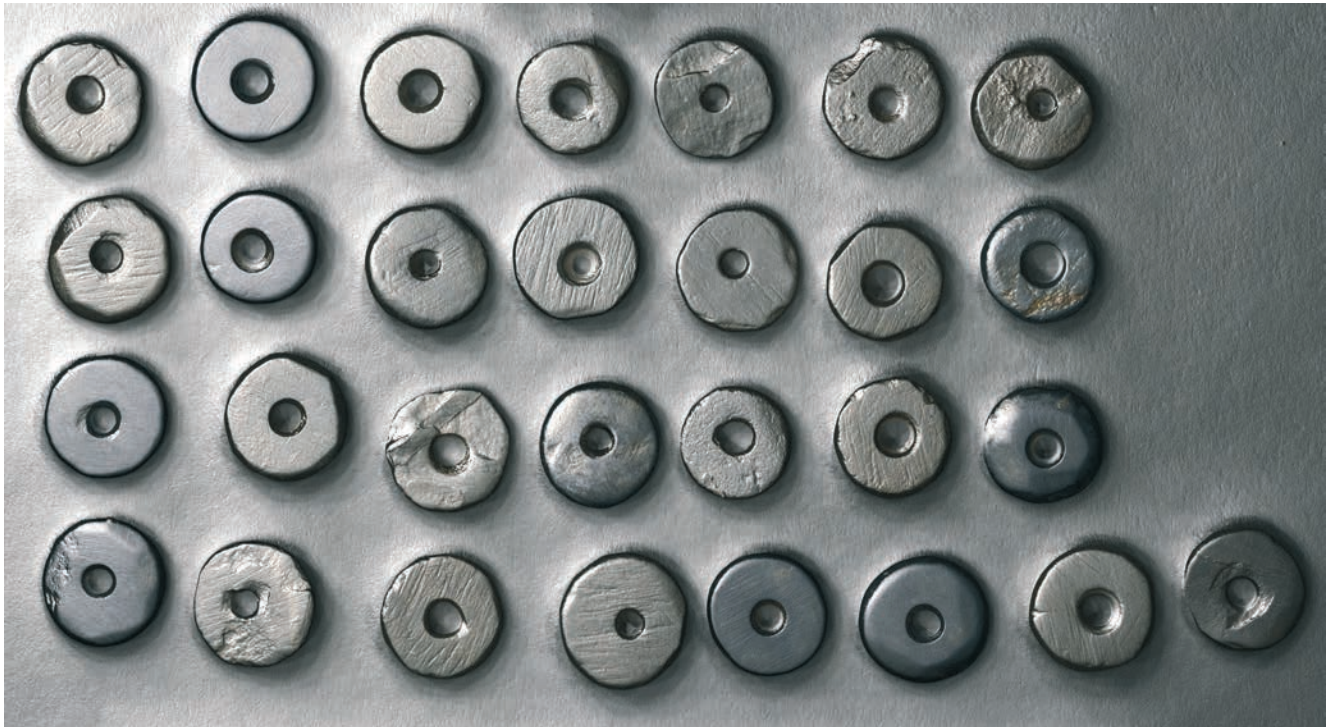


Figure 11.8 Specular enhancement rendering mode (unscaled composite; see Fig. 11.5 for scale) (photo by Lori Hager).



Figure 11.9 Luminance unsharp masking rendering mode (unscaled composite; see Fig. 11.5 for scale) (photo by Lori Hager).

around the edges of all but four beads, implying idiosyncratic behavior on the part of the bead-makers. Notable surface irregularities, or asperity, on at least eight beads highlight

the heterogeneous nature of the raw material and its effect on the resulting beads. Last, the luminance unsharp masking mode in the RTI Viewer provided improved glimpses of

abrasive and fatigue wear; it also enhanced the edges of the beads. Recognizable abrasions were found to extend onto the edges of at least one bead, suggesting multiple stages of planar and edge grinding and regrinding before accomplishing a desired form or bead refurbishment at a later date. Not only the domain of seasoned bead-makers, we envision a more encompassing description of steatite bead manufacturers comprising community members from all sections of society and resulting in the variation observed in steatite bead-making techniques and choices.

Conclusions

The collection of routine quantitative bead attributes coupled with a targeted RTI study of 29 steatite disk beads from CA-NAP-399 revealed a surprising level of dissimilarity for the relatively small steatite bead sample size attributed to the burial sample in the upper Napa Valley of California within a narrow 500-year timeframe (2450 to 1950 BP). Unlike other bead and material types that lend to greater uniformity in production and final product, qualitative features of steatite disk beads, made visible through the use of RTI, suggest the creation of steatite beads may have afforded more opportunities for innovation and experimentation irrespective of the skills that may or may not have been learned. For example, *Olivella* shell beads and even the obsidian bifaces that were produced intensively

onsite maintain greater regularity in form and closely follow technological and social conventions potentially practiced by a few savvy craft specialists.

RTI holds great promise for archaeologists to document the surface details of beads in a manner that can be accomplished in both field and laboratory settings. Given the small-scale of beads, our own eyes can fail to distinguish the important attributes that help archaeologists develop more robust histories of beads and bead-makers. We employed RTI to detail the process of bead manufacture, from the choices made at the quarry to bead design and bead formation. Through an examination of the 3-D surface details of these objects using RTI, we have shown how the steatite beads connect to the communities that made them, to the people who exchanged them, to those who may have worn them in life, and ultimately to the event of their deposition at the site, sometimes within a mortuary context where they are physically associated with an individual or larger community. We suggest that non-specialized behaviors were carried out by a broad cross section of society, leaving evidence of individuality in the steatite beads for purposes of adornment during life and/or for the acquisition and caching of items for use after death.

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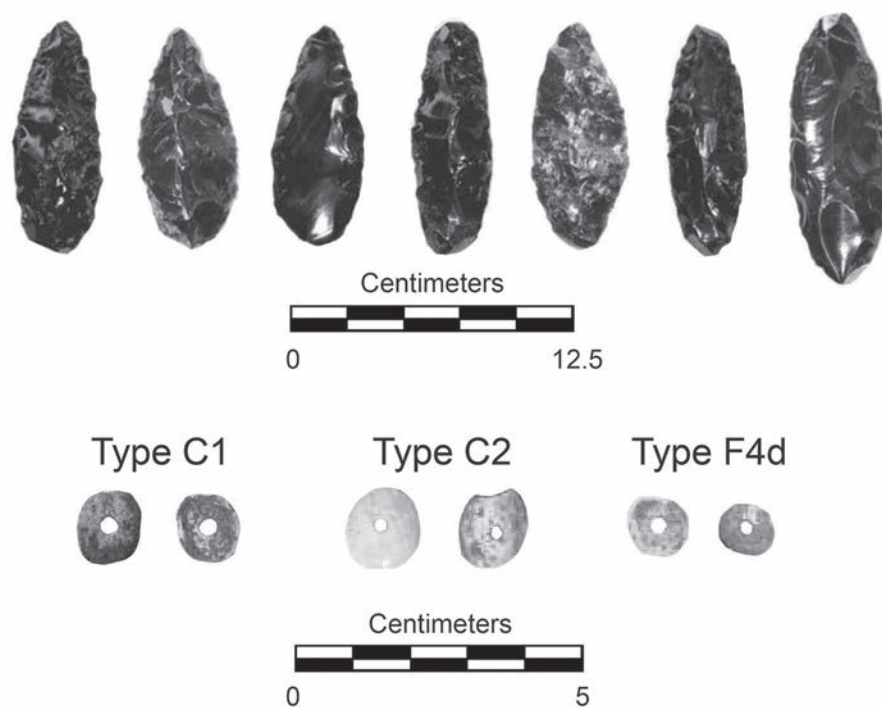


Figure 11.10 Selection of obsidian bifaces and *Olivella* shell beads from CA-NAP-399 (photo by Tsim Schneider).

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Part 4

Experimentation and Technology

Experimental Replication of Stone, Bone and Shell Beads from Early Neolithic Sites in Southeast Europe

Maria Gurova and Clive Bonsall

Abstract: *Flat disk beads made from a wide variety of biominerals, minerals and other stones are widely distributed on Early Neolithic sites throughout the Balkans. Replicative experiments indicate that hardness was a critical factor affecting drilling times and, presumably, the choice of materials for bead production. Using a pump drill and schist grindstone it was found that beads could be manufactured relatively easily from materials of less than 5 on Mohs hardness scale; materials harder than 5.5 either proved very difficult to drill or were not drilled successfully. The experiments suggest that, while some beads and necklaces were evidently specialist products, bead-making could have been a normal household activity among early farming communities in Southeast Europe.*

Introduction

Among the novel features of the Early Neolithic in Southeast Europe is the appearance of flat disk beads made of stone and other materials, which have close parallels at sites in the Near East where stone bead production underwent a significant expansion in the PPNA period (Wright and Garrard 2003). This bead type contrasts in form and technique with those found in Upper Paleolithic and Mesolithic sites in the Balkans, which often were made from whole shells and animal teeth (e.g. Cristiani and Borić 2012; Komšo and Vukosavljević 2011; Vanhaeren and d’Errico 2006).

Disk beads have been found in a number of early farming sites, including Franchthi and Nea Nikomedia in Greece (Miller 1996; Shackleton 1988), Galabnik in Bulgaria (Gurova et al. 2013), Anza in Macedonia (Gimbutas 1974), Blagotin, Divostin, Drenovac and Lepenski Vir in Serbia (Srejović 1972; Srejović and Babović 1983; Vitezović 2012) and Schela Cladovei in Romania (Bonsall and Boroneanț 2009). Their presence in “Final Mesolithic” (cf. Bonsall 2008) burials at Lepenski Vir and Vlasac (Borić and Price 2013) may reflect contacts between fishing communities in the Iron Gates and Early Neolithic farmers around 6000 cal BC (Fig. 12.1). A variety of materials were used for the

production of these beads, including marine shell, various green- and blue-colored minerals such as azurite, malachite and serpentinite, and “limestone” (Fig. 12.2).

Actual evidence of on-site production, in the form of production debitage or tools used in bead-making, has been found in only a few sites in the Balkans. In Early Neolithic levels at Franchthi Cave beads made from the shells of *Cerastoderma glaucum* (lagoon cockle) were found in association with broken bead blanks and flint microdrills (Fig. 12.3a; Perlès 2001). Morphologically similar microdrills of high quality flint (Fig. 12.3b) were recovered in large numbers from the site of Kovačevo in southwest Bulgaria, although not in direct association with beads or other perforated objects (Gurova et al. 2013). At Schela Cladovei, stone disk beads occurred in association with micro-borers of high quality “Balkan flint,” broken bead blanks and other production debitage (Bonsall and Boroneanț 2009).

An experimental program was devised to investigate various practical and technical aspects of the production of disk beads as represented in Southeast European Early Neolithic sites. Among the questions we sought to address were:



Figure 12.1 Locations of sites mentioned in the text (drawing by C. Bonsall).



Figure 12.2 Necklaces of disk beads from the Early Neolithic site of Galabnik (western Bulgaria). The materials used include shells, limestone, nephrite and serpentinite (Kostov 2007; Kostov and Bakamska 2004). The perforations consistently have a diameter of 1.2 mm (photos by M. Gurova, published with the permission of A. Bakamska).

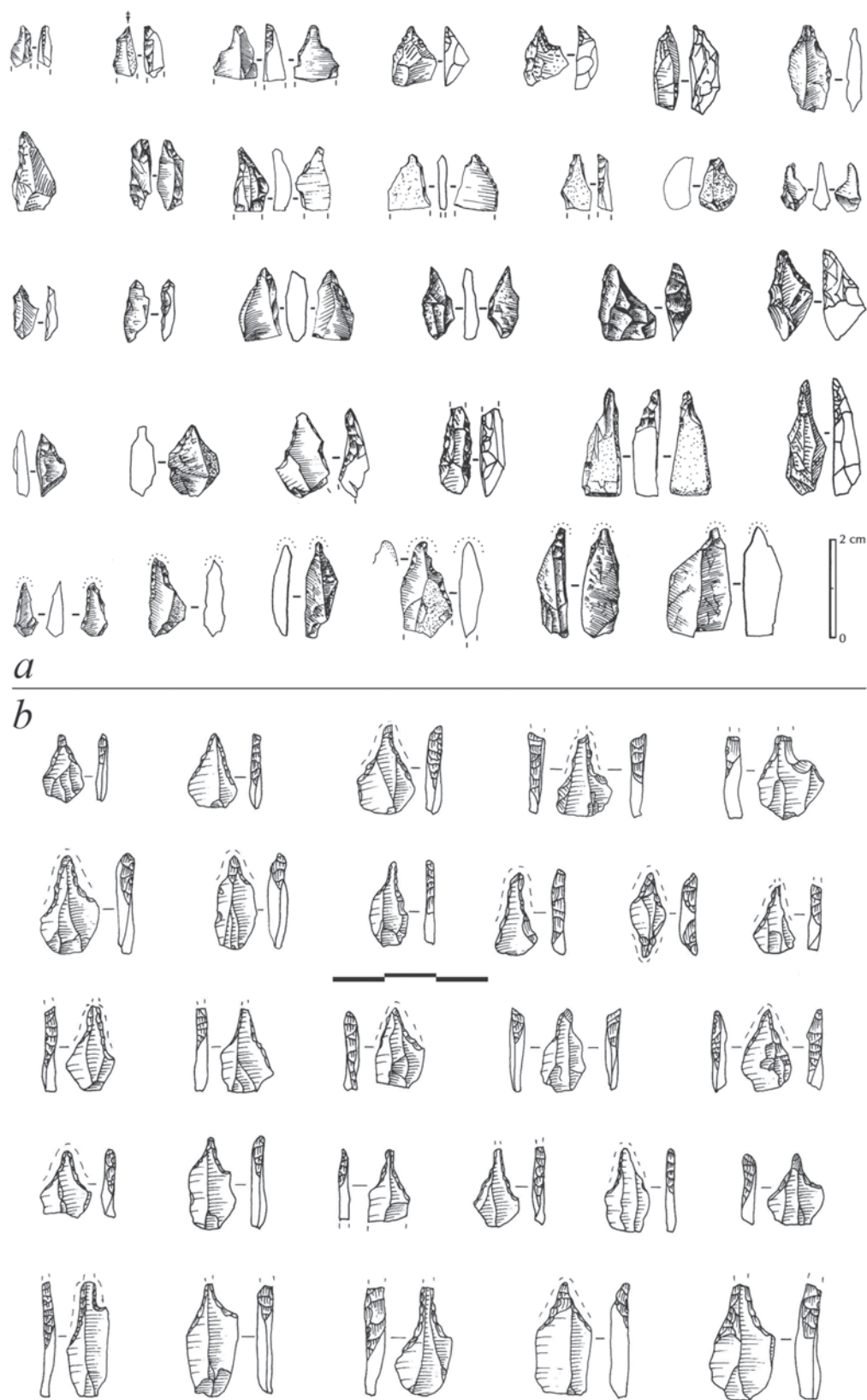


Figure 12.3 Archaeological micro-borers from Early Neolithic sites in Southeast Europe: a. Franchthi Cave, Greece, reproduced from Perlès 2004:fig. 6.4, with permission from Indiana University Press; b. Kovačevo, southwest Bulgaria (drawings by M. Gurova).

- How effective are the chert micro-borers found in some Early Neolithic sites in making holes in the various materials that were used for bead production?
- How much time is required to drill the holes and to produce beads?
- How do these factors affect the choice of materials for bead-making?

Details of the experimental program have been provided by Gurova et al. (2011, 2013). In the present paper, we summarize the results of the experiments and offer some further observations on the lessons learned.

Materials and Methods

Replicas of micro-borers from Early Neolithic sites were made using high quality cherts from Bulgaria, southern Romania and southern England (Fig. 12.4a). Samples of various rocks, minerals and biominerals that would have been available to Neolithic peoples in Southeast Europe were selected for experimental bead production. On Mohs scale of mineral hardness, the materials ranged from 6.5 to 2.5 (Tab. 12.1).

Tabular blanks were prepared by sawing, flaking and/or splitting of the samples to the required size. The blanks were then reduced in thickness by abrasion/grinding on a schist slab with fine sand and water, to form thin plates 2–4 mm thick, with flat, smooth surfaces. The plates were then drilled from one or both faces. The final rounding and polishing (finishing) of the beads was achieved by abrasion on a grinding slab with fine sand and water (Fig. 12.4b). Where very large tabular fragments could be obtained (from e.g. bone and

serpentinite) thinning and drilling were usually carried out before the blank was divided into smaller, bead-sized blanks (Fig. 12.4c–d).

Two forms of drill were used in the experiments – a pump drill and a thumb drill. The pump drill (Fig. 12.5a) has four components: a vertical drill shaft (spindle) and bit, a horizontal bar (crosspiece) with a hole in the center allowing it to slide up and down the spindle, a weighted disk or flywheel which is fixed to the lower end of the drill shaft, and a cord that is strung from either end of the crosspiece through a hole near the top of the drill shaft and twisted around the shaft. When downward pressure is applied to the crosspiece, the drill rotates. The flywheel captures this momentum, which when released at the end of the cycle rotates the drill shaft in the opposite direction as the cord is rewound. Thus, a continuous alternating rotation is generated (Follari 1993). A “thumb drill” is a much simpler device; the flint drill bit is held between thumb and fingertips and rotated back and forth with pressure (Fig. 12.5b). While the thumb drill is simple to use, it does not offer the speed or precision of a pump drill and there is less control over the verticality of rotation. Moreover, the drill bit needs to have a short, thick tip in order to resist breakage and a long, broad proximal end (shank) for grasping. The resulting perforation tends to be larger and less symmetrical than can be achieved with a pump drill.

A photographic record (still images and videos) was kept of the actual experiments, and microphotographs of manufacturing traces on beads/blanks and of use wear traces on drill bits were taken at magnifications of 20× to 100× using a Keyence VHX-100 digital microscope.

Table 12.1. Materials used in the bead-making experiments and drilling times. After Gurova et al. 2013, with Mohs hardness information from Henn (2004), Thomas (2009) and Lazzarelli (2012).

<i>Material</i>	<i>Color</i>	<i>Mohs hardness</i>	<i>Thickness (blank)</i>	<i>Drilling time (one hole)</i>
Nephrite	Variable	6.6–6	3 mm	No hole produced
Amazonite	Pale green	6.5–6	3 mm	130 min
Lazurite	Dark blue	5.5	3 mm	202 min
Bone		5	2 mm	12 min
Shell (bivalve) ¹		4	2–3 mm	10 min
Malachite	Green	4–3.5	3.5–4 mm	10 min
Marble	Pale gray	4–3	2.5–3 mm	12 min
Serpentinite ²	Green	4–2.5	3 mm	7–8 min
Limestone	Yellow	3	3 mm	3 min

1 Shells of two bivalve species, one freshwater (*Anodonta cygnea*, swan mussel) and one marine (*Mytilus galloprovincialis*, Mediterranean mussel) were used in the experiments. Drilling times were approximately the same for both species.

2 Serpentinite is a metamorphic rock composed of one or more serpentine group minerals and can have variable hardness.

Results

Drilling and Shaping

Table 12.1 summarizes the results of the experiments in drilling different materials. Attempts to produce beads from the hardest materials used in the experiments, amazonite and nephrite (Mohs 6–6.5), were only partially successful; drilling for up to 160 minutes with a pump drill made little impression on a piece of nephrite, while it took a total of 130 minutes to make a hole in amazonite at which point the bead broke in two.

Lazurite (Mohs 5.5) proved somewhat easier, but it still required a total of 197 minutes mechanical drilling in both directions with sand and water additives, replacing the drill bit once, in order to produce a biconical hole. A further five minutes of manual drilling were needed to enlarge the hole sufficiently.

The best results were achieved using materials with a hardness of less than 5 on Mohs scale. Bone blanks 2 mm thick were produced by sawing with an unretouched flint blade followed by abrasion on a schist slab. Three holes were drilled – one with a pump drill and two with a thumb drill – in 38 minutes. Sawing of the bone took 30 minutes, and 35 minutes were required for shaping the beads. Shell, malachite and serpentinite are all of similar hardness (Mohs 4). Drilling a hole through blanks 3–4 mm thick of these materials took no more than 10 minutes, using a pump drill.

The hardness of the material worked inevitably influenced the efficiency of shaping beads. Easiest to fashion were limestone beads (six were made in the experiments) while the four discoid beads of serpentinite (the most refined examples produced in our experiments) took twice as long to make.

In the case of the softest materials used in the experiments, marble and limestone (Mohs 3–4), a hole could be drilled in 3–8 minutes with a pump drill.

Use-wear and Technological Traces

Drill bits broke quite frequently, but on those that withstood prolonged use distinct wear traces could be observed. A drill bit used on malachite for 10 minutes with water added as a lubricant exhibited noticeable rounding of the tip, with numerous mineral residues on the tool and many microchips of flint in the hole created (Figure 12.6a). A flint drill bit used for 30 minutes to make four holes in a plate of serpentinite showed noticeable rounding and smoothing of the active part of the tool (Figure 12.6b). A drill bit used on amazonite for 15 minutes developed a small area of polish on the tip; more extensive micropolish was produced on a second drill bit, which was used for 130 minutes. Very pronounced smoothing and rounding of the drill tip and areas of polish also developed on a drill bit that was used to drill lazurite for 202 minutes (Fig. 12.6c). Twelve minutes drilling through marble produced significant micro-features of use on the drill bit, in the form of rounding, smoothing

and bright spotted polish with transverse striations (Fig. 12.6d). There were striking differences in the time taken for micropolish to form on the borer tips – from 12 minutes (on marble) to 202 minutes (on lazurite).

Apart from the hardness of the material being worked (from 2.5 to 6.5 on Mohs scale), the appearance of microwear traces was also found to vary according to the raw material of the drills – the polish resulting from drilling marble for a short time appeared on a *jasper* borer, while the drilling of amazonite and lazurite was done using *flint* drill bits with much slower development of micropolish on their edges and tips.

Holes drilled in some materials, most notably biominerals (bone and shell), showed pronounced rotational striations (Fig. 12.7a, b). In the case of serpentinite, manufacturing traces (abrasion) were readily observable on the perimeters of the experimental beads after rounding, although in our experiments no “rolling” of the beads on a grinding slab (as described by Wright et al. 2008) was performed for additional smoothing and faceting of their edges (Fig. 12.7c).

Discussion

Experimental studies of bead-making using ancient technologies are by no means new. Many researchers worldwide have shown interest in the social and technical aspects of beads made from stone, shells and other materials. There have been some notable studies aimed at a better understanding of Neolithic bead manufacturing in Anatolia and the Levant (e.g. Bains 2012; Coşkun 2008; Wright and Garrard 2003; Wright et al. 2008). However, the experiments described in this paper are among the first concerned with bead manufacturing technology in the Early Neolithic of Southeast Europe.

A number of general observations arose from this limited series of experiments.

The hardest materials that were drilled successfully were amazonite and lazurite (Mohs 6.5–5.5). However, drilling of these materials took a considerable time and involved several changes of the drill bit. Much easier to drill and shape into beads were bone, shell, malachite, serpentinite, marble and limestone (Mohs 5–2.5). Although nephrite and amazonite have similar rankings on Mohs scale, attempts to drill nephrite were unsuccessful. This may reflect differences in the *absolute* hardness of the samples used in our experiments and/or variations in other experimental conditions.

In general, however, the harder the material on Mohs scale, the longer it took to drill a hole. The process could be accelerated with the addition of water and fine sand, and these were found to be essential additives for bead/blank thinning and shaping by abrasion. The skill and experience of the drill operator was also a significant factor – in one experiment involving two individuals, one was able to drill

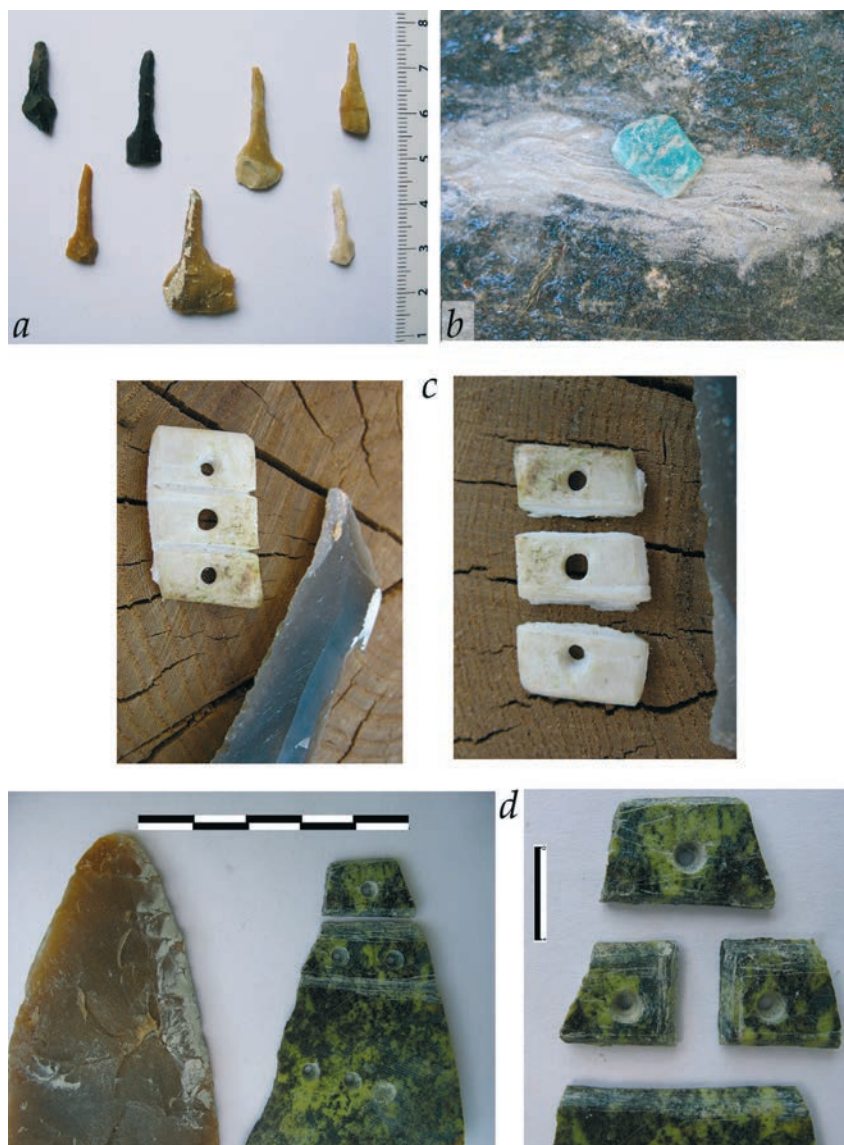


Figure 12.4 Equipment used in the experiments: a. experimental chert drill bits; b. preparing a bead blank on a grinding slab; c. producing beads from a bone plate; d. producing beads from a serpentinite plate (photos by M. Gurova).



Figure 12.5 Drilling equipment used in the experiments: a. pump drill; b. thumb drill (photos M. Gurova).

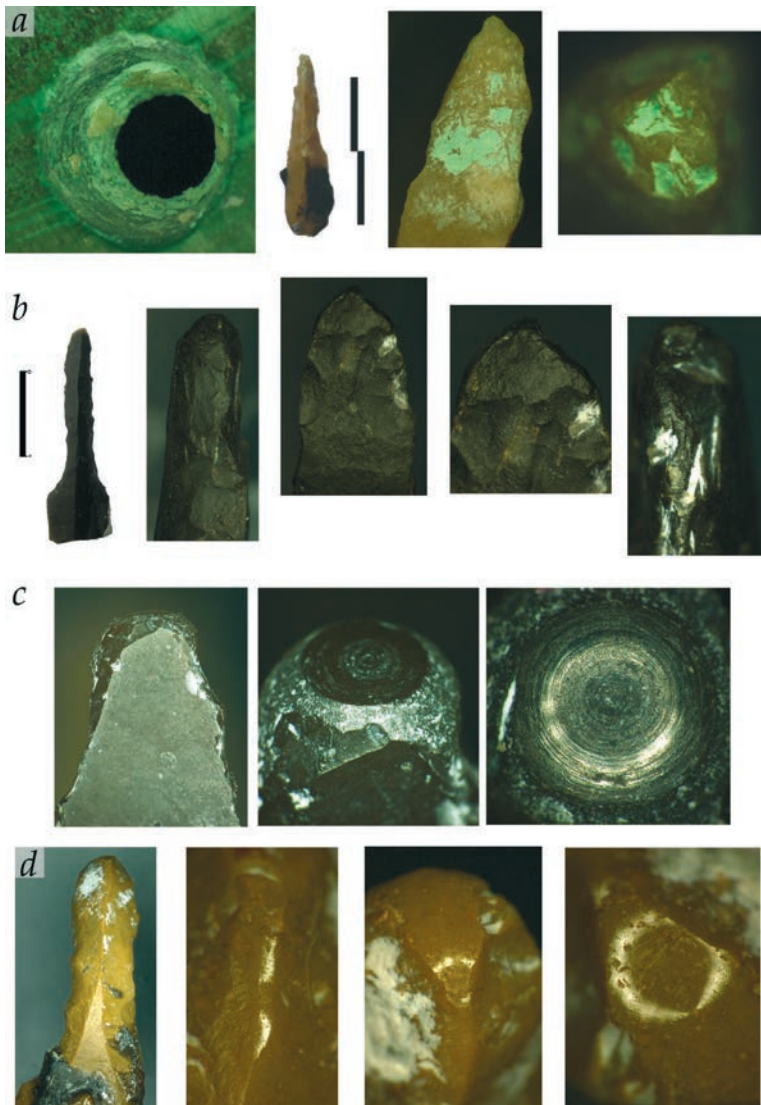


Figure 12.6 Photomicrographs of experimental drill bits showing microwear traces resulting from perforating: a. malachite (including the hole with flint chips from the drill); b. serpentinite (25 $\times$); c. lazurite (1–25 $\times$, 2–50 $\times$, 3–75 $\times$); d. marble (1–25 $\times$, 2–4–75 $\times$) (photos by M. Gurova).

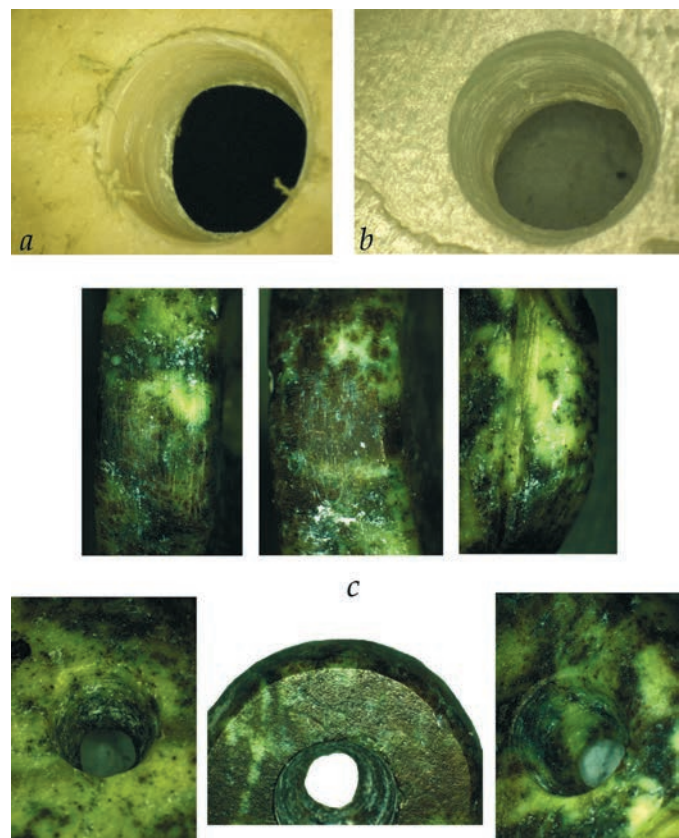


Figure 12.7 Photomicrographs of manufacturing traces: a. bone (50 $\times$); b. shell (50 $\times$); c. serpentinite (higher row – 50 $\times$; lower row – 40 $\times$ and 25 $\times$ in the middle) (photos by M. Gurova).

a hole in a plate of gray marble in 8 minutes, while the other took 12 minutes to drill through a blank of the same material and thickness.

Drill bits used in the pump drill broke quite frequently, although there was no obvious correlation between breakage and the hardness of the material worked.

In terms of use wear, rounding and matt smoothing are typical microwear features appearing on chert drill bits after prolonged friction with the worked material. Bright polish appeared in only three cases – in drilling marble (for 12 minutes), amazonite (polish spots starting to appear after 15 minutes) and lazurite with very pronounced rounding and polish on the drill tip after 202 minutes.

Conclusions

The results of the experimental program conducted by Gurova et al. (2013) and summarized here have provided useful insights into various aspects of disk bead production in the Southeast European Early Neolithic.

In these experiments, micro-borers made from high quality cherts (Mohs 7), and either used in combination with a pump drill or as simple thumb drills, proved effective in making holes in materials of less than 5.5 on Mohs scale of hardness. In general, the harder the material the more time was taken to drill a hole or to shape the bead. It was also observed that the addition of water and/or sand during drilling and shaping by abrasion usually accelerated both processes.

The technology available and the hardness of the drill bit are two factors likely to have influenced the choice of raw materials for bead-making. Of the bead materials recorded from Early Neolithic sites, only nephrite is harder than the materials successfully drilled in our experiments. Other factors that probably influenced the choice of materials for bead-making were availability and susceptibility to breakage of the material, along with the skill and experience of the bead-maker.

The bead-makers in our experiments all had little or no previous experience of bead-making yet were able to produce beads that are comparable in style and quality to some of those found in Early Neolithic contexts. Beads are often regarded as “prestige goods” and indicative of craft specialization. Some Early Neolithic examples from Southeast Europe, such as the bead necklaces from Galabnik, may well be the work of specialist craftsmen. It is possible, however, that bead-making in the Neolithic was also a common household activity, like weaving or pottery manufacture, although this need not imply that it was always done for household consumption.

The experiments described in this paper represent the first stage of a longer-term study of bead-making in Early Neolithic Southeast Europe. Further steps in the research

will involve experiments with other forms of hand- and mechanical drills, and use-wear analysis of archaeological chert micro-borers for comparison with experimental drill bits.

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The Reproduction of Small Prehistoric Tusk Shell Beads

Greg Campbell

Abstract: *Very small tusk shell (“Dentalium”) beads were produced during some parts of the Natufian Paleolithic, but how and why such small beads were made has not been established. The time required for gathering modern tusk shells, and for manufacturing small beads from them using several simple techniques, were recorded and compared. The techniques produced distinct use-wear patterns on the lithic edges used. The dimensions of the beads were compared between techniques and to a sample of Natufian beads. Simple scribing against a sharp lithic edge easily produced good yields of small beads; snapping by hand, pressing against a sharp edge, and percussion did not. Bead length–diameter distributions showed Natufian beads were made from parts of tusk shell too robust to snap by hand.*

Introduction

Humans have been wearing marine shells as beads for at least 100,000 years (Bar-Yosef Mayer et al. 2009; Vanhaeren et al. 2006; Grün et al. 2005), and the practice continued at least occasionally throughout the Middle Paleolithic (d’Errico et al. 2005; d’Errico et al. 2009; Vanhaeren et al. 2006). Intentionally making marine shells into beads began to be common about 40,000 years ago (Kuhn et al. 2001). In the Upper Paleolithic, marine shells for use as beads were transported far inland across the Near East, Europe and the western Mediterranean (Álvarez-Fernández and Jöris 2006; Bar-Yosef 1989; Bar-Yosef Mayer 2005; Jacobi and Higham 2008; Simpson 2003:45; Taborin 1993); some burials of the period included thousands of shell beads (e.g. Vanhaeren and d’Errico 2001). Marine shells continued to be used for beads in Mesolithic Europe (Álvarez-Fernández 2010; Simpson 2003) and in the Epi-Paleolithic Near East (Bar-Yosef 1989; Bar-Yosef Mayer 2005).

Creating an object with the sole purpose of it being seen demonstrates that seeing the object conjures up some suite of meanings in the beholder’s mind; beads are evidence of the ability to operate symbolically, a critical development in human cognition (Álvarez-Fernández and Jöris 2006; Bednarik 2008; White 1992). Many Paleolithic archaeologists therefore see bead use as diagnostic of anatomically modern humans (e.g. Álvarez-Fernández and

Jöris 2006:40; White 1993:294, 2007:291). Many have dismissed the few beads from Neanderthal contexts as lost, copied, scavenged or stolen (e.g. White 1993:279), although recent evidence and reinterpretation of older evidence makes it likely that Neanderthals used beads (Bednarik 2008; Zilhão 2007:37; Zilhão et al. 2010).

Comparatively little has been said about the personal in the study of early personal adornment. Many archaeologists have been exercised by the contrast between the localized use of beads in small numbers in the Middle Paleolithic, and the widespread use of beads of standardized forms in substantial numbers in the Upper Paleolithic (e.g. Álvarez-Fernández and Jöris 2006; Bar-Yosef Mayer 2005; Kuhn et al. 2001:7645). Archaeologists have been principally concerned with beads as indicators of the emergence of modern cognition (Bednarik 2008; d’Errico et al. 2009; White 1992; Zilhão 2007), of the emergence of language (e.g. d’Errico et al. 2005:20), of position within a group’s social hierarchy and its inheritability (Vanhaeren and d’Errico 2001; White 1993:296), of membership of a particular ethnic group (Bar-Yosef 1991; Kuhn et al. 2001:7645), of the rate at which distinct ethnic groups emerge over time (Vanhaeren and d’Errico 2006; but see White 2007), and as indicators of the emergence of craft specialization (Miller 1996; Trubitt 2003). While cultural norms can restrict the range of what is regarded as acceptable adornment for individuals by their peers, what

each individual wears remains principally an individual choice. Modern ethnographic studies of beads (Sciama and Eicher 1998; Vanhaeren 2005) show that archaeologists simplify the cultural roles of beads at their peril. Bednarik (2008:297) noted beads have both private meanings and associations for the wearer as well as public ones for the observers. A prehistoric marine shell bead is “not only mere decoration, but has the potential to bring to mind to their wearers a certain memory or experience that the shells are associated with” (Bar-Yosef Mayer 2005:177). Some beads could have been collected simply for their aesthetic appeal, or as souvenirs (Bar-Yosef et al. 2009:313). In the prehistoric Australian context Balme and Morse (2006:808) suggested early beads “convey self identity,” and become markers of ethnicity only for later cultures. This also seems a sensible explanation for the contrast in Old World Paleolithic bead use (Kuhn et al. 2001:7645): beads were sparse and idiosyncratic in the Middle Paleolithic because the meanings they bore were primarily individual, while they were common and more standardized in the Upper Paleolithic because their meanings were primarily social. The elaboration of bead use during the Paleolithic is likely a consequence of increasing social complexity, rather than increasing human mental capacity.

Several past cultures made beads from tusk shells, the shells of mollusks in the class Scaphopoda Bronn, 1862. These shells, with a narrow conical gently curved shape like elephants’ tusks, are naturally hollow, which make them excellent raw material for beads (Reese 1991:613). Tusk shells are a small and simple class of mollusks; only two orders account for the 46 genera of 517 living species (Steiner and Kabat 2001). In the living animal (Fig. 13.1),

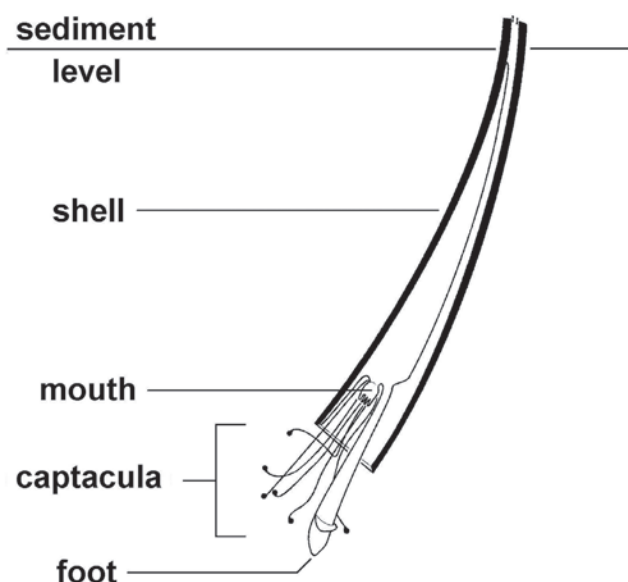


Figure 13.1 Schematic view of left side of a tusk shell in life-position, with left half of shell removed to show features. After Jones and Baxter (1986:fig. 24). All illustrations prepared by the author.

the wider (anterior) end of the shell houses a rudimentary eyeless head, several small feeding tentacles (captacula) (Pilsbry and Sharp 1897:v) and an extensible burrowing foot (Trueman 1968). Tusk shells are small (seldom over 100 mm long and 6 mm wide), too small to be worth gathering by humans for food. They live buried in offshore muds and sands with the narrow (posterior) ends of their shells projecting above the sediment surface, searching the sediment for microscopic food particles with their captacula (Jones and Baxter 1987:94). The evolution of tusk shells, and their relationship with other mollusk classes, are a long-standing conundrum (Pilsbry and Sharp 1897:xi), because tusk shells have a radula and conical shell like the gastropods, a burrowing foot and simplified head like many bivalves, and anterior feeding tentacles like cephalopods. Thought to have descended from the extinct mollusk class Rostroconchia along with the bivalves (Steiner 1992:386), recent genetic analyses suggest they descended from the gastropods via the same line that produced the cephalopods (Passamanek et al. 2004:35–36; Steiner and Dreyer 2003).

Archaeologists often refer to beads made from tusk shells as “Dentalium” beads (Bar-Yosef Mayer 2008:104; Reese 1991:613) because almost all beads came from species long thought to be in the single genus *Dentalium* (Emerson 1962:467–468; Pilsbry and Sharp 1897:xxix). This genus was subsequently broken up (Emerson 1962:468; Steiner and Kabat 2001:435) and the European and Mediterranean types used for beads are now in the genus *Antalis* (e.g. Hayward and Ryland 1990:634). A wide range of tusk shell types, both living and fossil, were used for beads (e.g. Bar-Yosef Mayer 2005:180). However, identification of the exact species used is often not possible because marine erosion and bead manufacture often remove the diagnostic characters (e.g. Balme and Morse 2006:805).

The earliest known tusk shell bead appears to be from Level E–E2 at Üçağızlı Cave on the Mediterranean Turkish coast (Stiner et al. 2002:34), bracketed by AMS radiocarbon dates of $32,700 \pm 760$ and $34,000 \pm 690$ BP (all dates are uncalibrated; Kuhn et al. 2001:7644). The few examples from Layer G at Riparo Mochi in northwest Italy may be even earlier, at 32,000–36,000 BP (Stiner 1999). Those from early Upper Paleolithic Levels VIII–X in the Levant rockshelter of Ksâr 'Akil (van Regteren Altena 1962:98) were dated to about 32,000 BP (Kuhn et al. 2001:7642). Tusk shell beads were in use in Australia soon after, about 30,000 BP (Balme and Morse 2006:806).

Prehistoric tusk shell beads are most famous in Pacific North America, where they were used from about 7,500 years ago (Erlandson et al. 2001). Here, tusk shell bead exchange networks extended and elaborated during prehistory, supplying many thousands of beads along the coast and deep into the continent (Andrews 1989; Clark 1963). Most of the tusk shells were supplied by the one or two tribes that occupied the limited part of the coast rich

in shells (Andrews 1989:91–94; Clark 1963:13). Historical documentation shows these tribes fished for tusk shells at well-known harvesting grounds offshore, using several types of spear-like brushwood brooms weighted with stones (Andrews 1989:96–109; Barton 1994; Clark 1963:13–16).

During the early Upper Paleolithic, the tusk shell became the dominant marine shell bead in Europe, while small spherical gastropods were the more common shell bead in the Near East (Zilhão 2007:38–39). Later, in the Upper Paleolithic and Epi-Paleolithic in the Near East, beads were made regularly from tusk shells (Reese 1991:624) and became more common over time (Bar-Yosef 1991:629).

The late Epi-Paleolithic Natufian culture of the Levant is famous for its tusk shell beads (Bar-Yosef 1991:629). Early Natufian tusk shell beads were relatively large and common in occupation debris and in graves (often as head adornments), but burying beads with the dead became less common during the Late Natufian, and was abandoned during the Final Natufian. Tusk shell beads were distinctly smaller in the Final Natufian (Bar-Yosef Mayer 2008:105), typically only 1–3 mm long at some sites such as Eynan (Bar-Yosef Mayer 2005:180), also called Ain Mallaha (Valla 1991). Very small tusk shell beads were occasionally made during the early Epi-Paleolithic, such as at Ohalo II on the Sea of Galilee (Bar-Yosef Mayer 2005:179). Tusk shell beads were used by later (Neolithic and Chalcolithic) cultures in the Levant, but not by sedentary agriculturalists, so the beads may have acted as a badge of nomadism (Bar-Yosef Mayer 2008:108).

Why tusk shell beads should have become smaller at certain times such as the Final Natufian is a matter of debate. Small tusk shell beads may have been common because they became fashionable due to the advent of some advanced bead-making technique, or they may have become common because of a shortage of tusk shells, and made by the refined use of simple techniques already used to make larger beads (Bar-Yosef Mayer 2008:107). Bar-Yosef Mayer (2008:107) suggested that a shortage of tusk shells in the Final Natufian forced bead-makers to make shorter beads to produce the same number of beads from less raw material. Attempts have previously been made to reproduce archaeological tusk shell beads (Vanhaeren 2002:45), including small Natufian beads (Larson 1978; Maréchal 1991:594), but sizes of the reproduced beads were not reported. This study aimed to assess the ease of preparing small tusk shells with Stone Age technology by assessing the results of making beads using simple techniques and by comparing the sizes of the resulting beads.

Methods

Gathering Shells

A 2.6 km portion of the famously shell-rich Knoll Beach, Studland, in the Isle of Purbeck, Dorset, England was searched by two people over a single tidal cycle in

November 2010. All tusk shells found were collected as raw material for bead-making. Each shell recovered had its maximum length and diameter at anterior and posterior ends measured to ± 0.1 mm using vernier calipers.

Archaeological Tusk Shell Beads

As an archaeological example of tusk shell bead sizes, measurements of length and largest diameter of the 88 tusk shell beads recovered from the Final Natufian levels at Eynan, Israel, which were intact enough to measure, were kindly provided prior to publication.

The length distribution of the Eynan beads was investigated by generating the usual statistical parameters (notably skewness and kurtosis), and by plotting the distribution as a histogram at 0.5 mm intervals. Cluster analysis using the unweighted pair-group arithmetic mean (UPGMA) method and Euclidean distance as the separation measure was also applied to the Eynan bead lengths (Hammer and Harper 2006:67–70). Since only one measurement, length, was analyzed, this distance measure simplifies to the length difference between pairs of beads.

Bead-Making Techniques

Several techniques were employed to reduce a tusk shell into potential beads (Fig. 13.2):

- Snapping by bending the shell between the fingers, using the butted thumbnails as a fulcrum.
- Using upper body weight to press the shell against the edge of a flint flake.
- Cleaving beads free from the shell, with a flint flake struck with a wooden stick.
- Scribing the shell against the flake edge with a to-and-fro motion at one point until the bead came free.
- Scribing all around the shell.
- Scribing at one point through into the central cavity, and then striking with a wooden stick.
- Scribing all around the shell while it was gripped in a “chuck” formed by the split end of a “green” hardwood stick (here, a short section of olive, *Olea europea*, of about 20 mm diameter). It was very difficult to grip the shell with the fingers when the attempted bead was very short, or the remaining shell was very short (less than ca. 10 mm), so a chuck was used to try to grip the shell reliably.

Measurements and Statistical Tests

The time in minutes required to convert each shell into beads was recorded. Each bead had its length and maximum diameter measured to ± 0.01 mm using a micrometer. Usually the beads were so small that there was no measurable

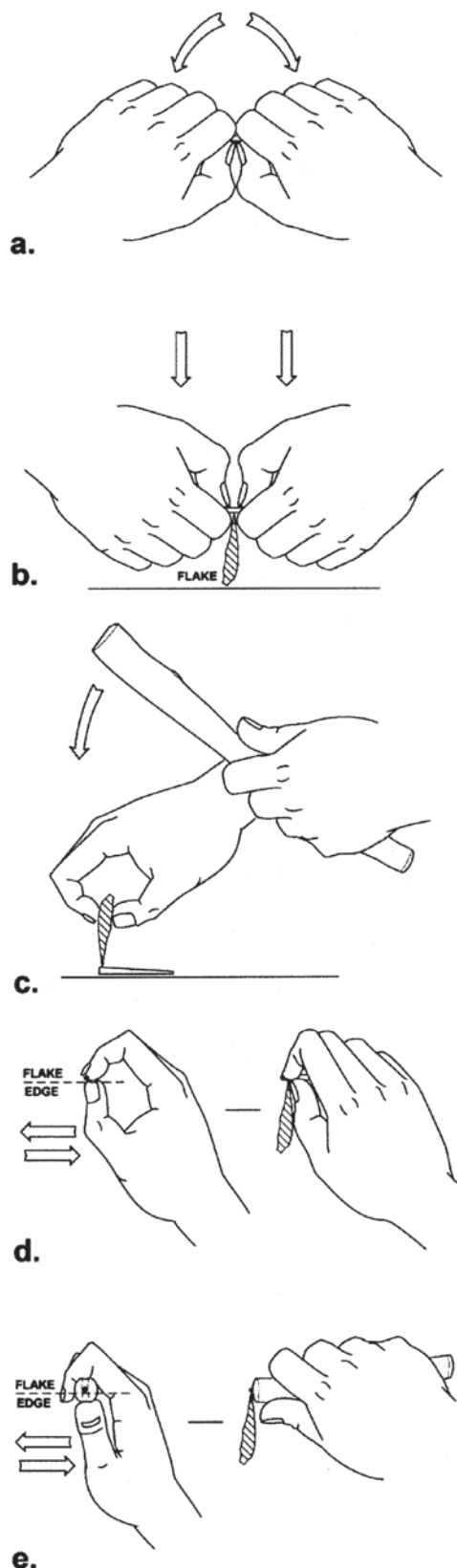


Figure 13.2 Bead-making techniques: a. snapping; b. body-weight; c. cleaving; d. scribing; e. scribing using a split greenwood stick as a chuck.

difference between anterior and posterior ends of the bead. An average bead-making time was calculated for each technique by dividing the total time spent on a technique by the number beads made. A yield measure was calculated for each technique by expressing the total length of beads made as a percentage of the total measured length of the shells used.

Statistical tests were performed using the paleontological freeware package, PAST version 1.91 (Hammer and Harper 2001). Differences were said to be statistically significant if a test showed the probability (p) of their being the same due to chance alone was less than one in twenty ($\alpha < 0.05$).

For each bead-making technique, significant departures from a Gaussian (normal) distribution in bead length or diameter were determined by the Shapiro-Wilk test, since it performs better than the χ^2 test when sample sizes are small (Hammer and Harper 2006:19–21). Whether the typical bead lengths or diameters were significantly different between techniques was determined by a one-way analysis of variance (ANOVA, which relies on the samples being roughly normally distributed and their spreads around their means being at least comparable), and by a Kruskal-Wallis test (a so-called non-parametric test, since it is much less reliant on the nature of the distribution and the nature of the spreads) (Sokal and Rolph 1995:423). Where distributions were unlikely to be normal, significant differences in bead diameters and lengths between techniques (so-called *post-hoc* comparisons) were determined using the non-parametric Mann-Whitney test (Sokal and Rolph 1995:427) with the Bonferroni correction (Sokal and Rolph 1995:240).

Results

Gathering Shells

The Knoll Beach survey recovered 27 shells (Fig. 13.3), with a length range of 16.4–33.2 mm and mean of 24.3 ± 4.8 mm, and an anterior (larger) diameter range of 3.04–5.29 mm and mean of 4.11 ± 0.58 mm. If strung together these 27 shells would have made a necklace 60.7 cm long. While most had lost the posterior septum, they could be identified as *Antalis entalis* (L.); only one bore the fine longitudinal striations of *A. vulgare* (da Costa) (Hayward and Ryland 1990:634). These shells were more common than expected, and they were not randomly distributed across the beach but were concentrated in the mid-tidal bands of coarse sand, fine gravel and occasional shells laid down by the retreating tide on the open sandy surface (Fig. 13.4), and in the spaces between rocks in rocky patches. With only an hour's practice most were recovered by surveying these coarse bands at a slow walk, and then proceeding rapidly to the next band on the shore. Their distinct shape meant they could be distinguished fairly easily from other shells, only being confused with the disarticulated dactyli of crab chelae.

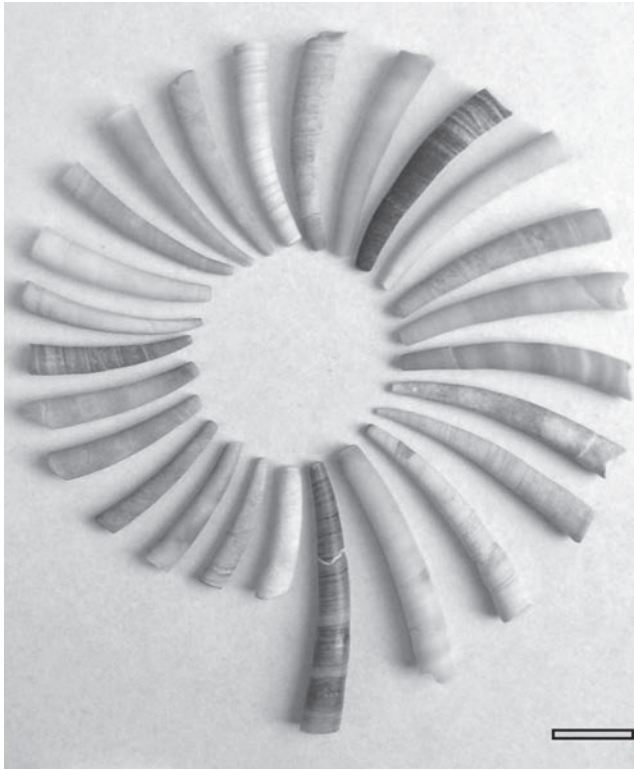


Figure 13.3 Tusk shells collected during one low-tide cycle at Knoll Beach, Studland, Dorset, UK: Nov. 2010. Scale: 10 mm.

Bead-Making Techniques

For each bead-making technique, the yield, average bead-making time, average length of flake edge needed per bead, and length and diameter statistics for the beads produced are shown in Table 13.1, ordered by increasing average bead length. The distributions of the lengths of beads made by the various techniques are shown in Figure 13.5. Segments of shell less than 6 mm long were very difficult to grip well enough to snap, and were strong enough that the shell ends painfully deformed the flesh of the fingers rather than breaking. With bodyweight pressing, segments of shell less than about 6 mm were usually strong enough to support the bead-maker's weight without breaking. It was almost impossible to make a bead less than 3 mm long with these techniques. Some scribing against the flake edge was needed during bodyweight pressing to separate a bead; otherwise, the shell refused to break or was crushed. The thicker-walled part of the shell (the posterior half) was clearly harder to make into beads by snapping, bodyweight pressing, or cleaving. During scribing-and-striking, 16 of the 21 beads made came free during scribing without having to be struck so the technique effectively acted as scribing free. Techniques that used scribing without striking all produced several very small beads from a shell (Fig. 13.6). These techniques all made beads of similar average sizes (around 1.6 mm: Table 13.1), with chuck scribing on average producing the smallest beads.

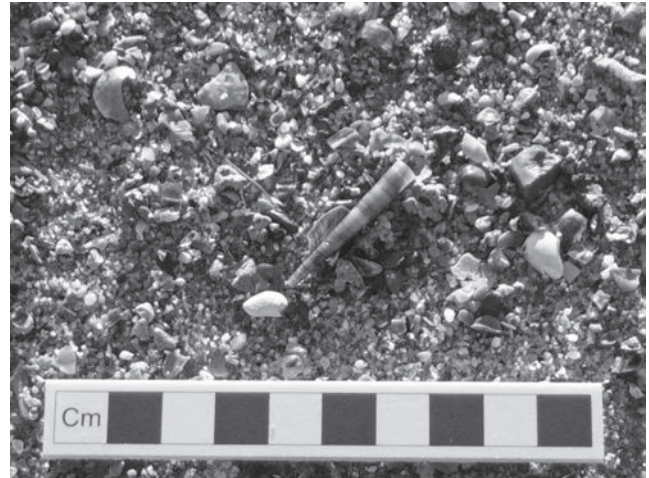


Figure 13.4 Tusk shell in band of coarse sand and shell on surface of sandy beach. Knoll Beach, Studland, Dorset, UK: Nov. 2010.

The techniques produced beads of very significantly different average lengths (ANOVA: $F = 50.3$; $df = 6, 175$; $p = 1.3 \times 10^{-35}$; Kruskal-Wallis: $H = 89.34$; $p = 4.5 \times 10^{-17}$). Bead lengths were seldom normally distributed for a technique (Shapiro-Wilk test: Tab. 13.1). Therefore, the results of the Kruskal-Wallis tests were more trustworthy than ANOVA, and Bonferroni-corrected Mann-Whitney tests were used for *post-hoc* pair-wise comparisons. These showed average lengths of bodyweight beads and snapped beads were not significantly different, but both of these were significantly different from the five other techniques. The other techniques did not have statistically significant different average bead lengths.

The techniques produced beads of very significantly different average diameters (ANOVA: $F = 2.60$; $df = 6, 175$; $p = .019$; Kruskal-Wallis: $H = 15.11$; $p = .019$). The bead diameters were seldom normally distributed for a technique (Shapiro-Wilk test: Tab. 13.1), so non-parametric Bonferroni-corrected Mann-Whitney tests were used for *post-hoc* comparisons. These showed that differences in average bead diameters between techniques were not statistically significant.

Yield as calculated here is a crude measure. Since the shell is curved, it is quite possible that total length of beads made was longer than the measured shell length. A yield less than 100% is quite poor. Tusk shells were surprisingly strong, especially when segments were short. Snapping very short beads tended to smash the shell end rather than make a bead, so snapping produced only small numbers of beads. The shells' tendency to crush under bodyweight pressing meant this technique had quite a poor yield. With cleaving, the chance of smashing the shell end rather than making a bead increased as attempted bead length decreased, so this technique also had a poor yield when used to make small beads. Striking during scribe-and-strike usually smashed

Table 13.1 Dimensions of tusk shell beads produced by various manufacturing techniques.

technique	no. shells	no. beads	yield (%)	avg mins/bead	mm flake/bead	bead length (mm)							bead diameter (mm)						
						mean	s.d.	min	max	skewness	kurtosis	P:(normal)	mean	s.d.	min	max	skewness	kurtosis	P:(normal)
scribe in chuck	2	33	100	2.0	8.3	1.48	0.38	0.65	2.23	-0.14	-0.32	.67	2.79	0.89	1.50	4.33	0.12	-1.27	.08
scribe and strike	3	21	45	2.5	5.0	1.51	0.39	0.86	2.05	-0.26	-1.27	.15	3.40	0.66	2.19	4.49	-0.25	-0.61	.78
scribe til free	2	36	109	2.1	6.3	1.59	0.42	1.04	2.66	1.15	0.88	.002	3.51	1.22	1.21	5.16	-0.49	-1.09	.008
scribe all round	2	34	124	4.0	4.1	1.66	0.41	0.69	2.71	0.62	1.51	.06	3.47	0.84	1.66	4.80	-0.56	-0.64	.31
cleaving	3	23	60	0.5	3.3	1.99	0.66	0.84	3.40	0.44	-0.40	.67	3.15	0.71	2.20	4.30	0.27	-1.50	.02
body weight	3	16	77	1.1	3.9	3.84	0.88	2.42	5.29	0.21	-0.87	.56	3.39	0.73	2.17	4.19	-0.40	-1.46	.03
snapping	5	19	91	0.5	0	5.74	2.91	2.39	12	0.94	-0.29	.019	3.05	0.92	1.67	4.85	0.44	-0.73	.55
Eynan (fin nat)	-	81	-	-	-	3.84	3.62	0.80	22.9	3.37	13.12	3×10^{-13}	2.77	0.65	1.70	4.80	1.28	1.82	6×10^{-6}
Eynan < 6 mm	-	74	-	-	-	2.93	1.31	0.80	5.7	0.55	-0.55	.002	2.70	0.58	1.70	4.80	1.32	2.54	3×10^{-5}
Eynan < 2.6 mm	-	33	-	-	-	1.75	0.42	0.80	2.4	-0.11	-0.71	.30	2.57	0.40	1.70	3.60	0.18	0.93	.28

the end of the shell rather than forming a bead, so this technique had the worst yield of all. Scribing techniques without percussion all had good yields of beads. Gripping in the chuck when scribing the large thin-walled anterior end of shells could easily be too hard, crushing the shell end or breaking the shell in the chuck, so this technique had the poorest yield of the scribing techniques.

A surprising amount of flint was needed to make the beads. Scribing used up 4–6 mm of flake edge for an average bead; each tusk shell needed 80–120 mm of flake edge. Quite rapidly the flake edge lost many very small flakes on the side facing the gripping hand, forming a finely saw-toothed edge with a polished band about 3 mm below (Fig. 13.7). The edge was too worn to use when about 0.6 mm wide (Fig. 13.8). Cleaving, and to a lesser extent scribe-and-strike, stuck off much larger flakes, making a coarsely serrated edge (Fig. 13.9). While cleaving made the most efficient use of flake edge, it still used up over 3 mm per bead. Bodyweight snapping required some scribing motion, so the amount of flint required was only slightly less than the scribing techniques. Chuck-scribing blunted flint most rapidly, probably because of abrasion of the flint by the wood of the chuck.

The various techniques produced beads of differing quality. Most of the beads made by cleaving, and many made by scribe-and-strike, had very irregular faces, and cracks running into the bead; simply measuring bead length broke one bead from each shell used for scribe-and-strike. The other scribing techniques seldom produced a neat and transverse bead face, and it was almost automatic to remove burrs and re-straighten the free edge of the gripped shell by polishing it vigorously against the flake face, prior to commencing work on the next bead. This “squaring-up” left crude broad “stripes” of polish on the flake face (Fig. 13.7). Scribing all

round produced the most ragged-edged beads of any scribing technique, leaving a step or flange along the bead edge (Fig. 13.10). Scribing-free seemed to make the tidiest beads.

Snapping and cleaving were the fastest bead-making techniques, turning out a couple of beads a minute; most of the time was spent repositioning the shell to make the next bead. Much time was wasted trying to snap shell ends so short they were too strong to snap, either in the fingers or by using bodyweight. Scribing techniques took much longer than snapping or cleaving, requiring about two minutes to make a bead. Bodyweight required some scribing, so its bead-making time was intermediate between scribing, and snapping or cleaving. Scribing all around the shell circumference took longer on average than scribing techniques, which concentrated on one point on the shell.

Final Natufian Beads

The lengths of the 88 Final Natufian beads from Eynan were clearly not normally distributed (Tab. 13.1) or even a continuous distribution: the larger beads (over 6 mm long) were more or less randomly distributed across their length range (7.1–22.9 mm). The length distribution of the beads less than 6 mm long was slightly positively skewed and significantly different from normal (Tab. 13.1) and multimodal, with peaks at about 2 mm and 3.5 mm (Fig. 13.5). Cluster analysis of the length of these beads (Fig. 13.11) distinguished the ten beads 4.8–5.7 mm long (averaging 5.35 ± 0.36 mm) from the beads with lengths of 4.4 mm or less; these smaller beads were separated into 31 short beads (2.6–4.4 mm long, averaging 3.41 ± 0.48 mm; 35% of the beads) and 33 very short beads (0.8–2.4 mm long, averaging 1.75 ± 0.42 mm; 37% of the beads). The length

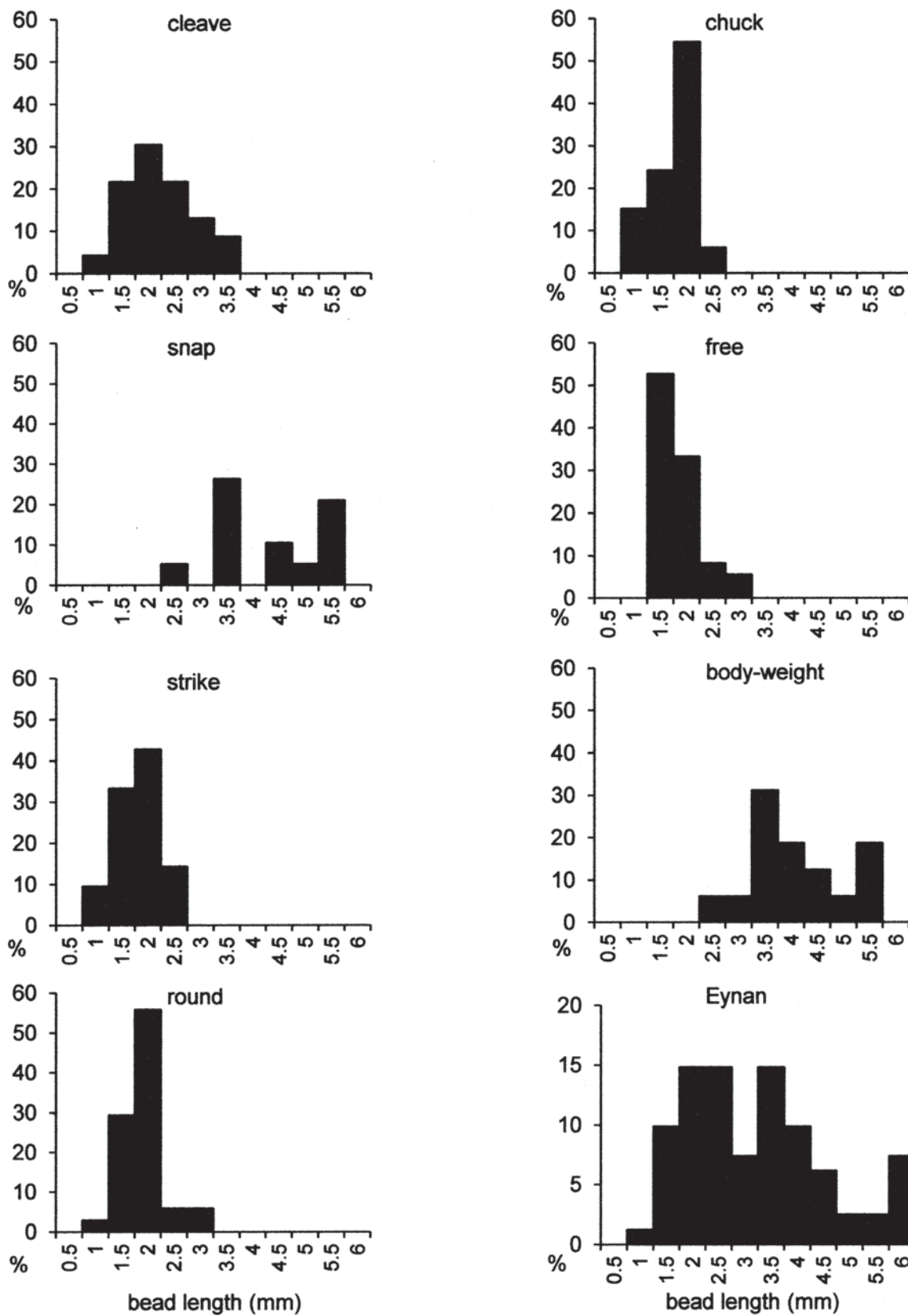


Figure 13.5 Histograms of the distribution of lengths of beads made by the various experimental techniques, and the smaller beads (< 6 mm) from snapping and from Final Natufian Eynan.

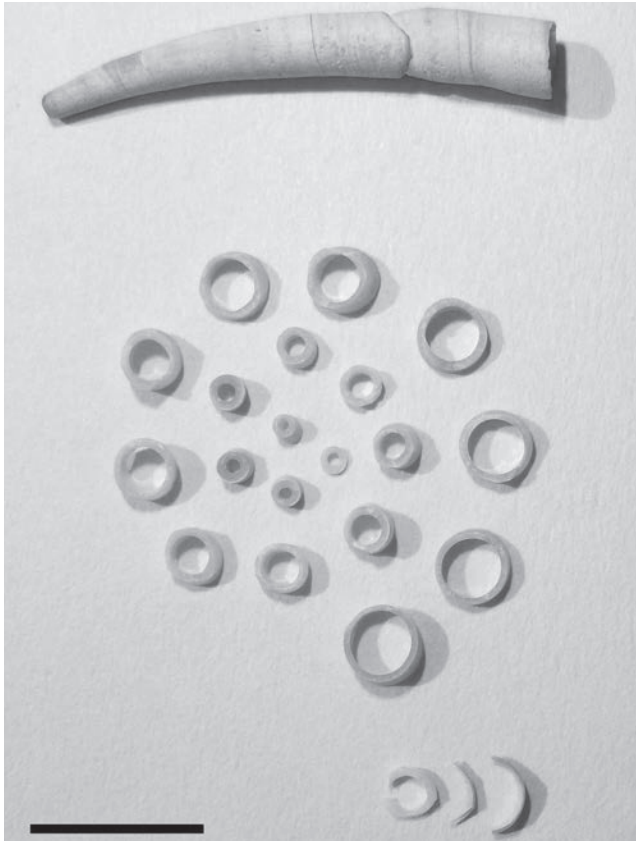


Figure 13.6 Tusk shell collected from Knoll Beach, Dorset, UK, Nov. 2010 (top); beads scribed free from a tusk shell of similar size (middle); larger waste pieces from bead-making (bottom right). Scale: 10 mm.

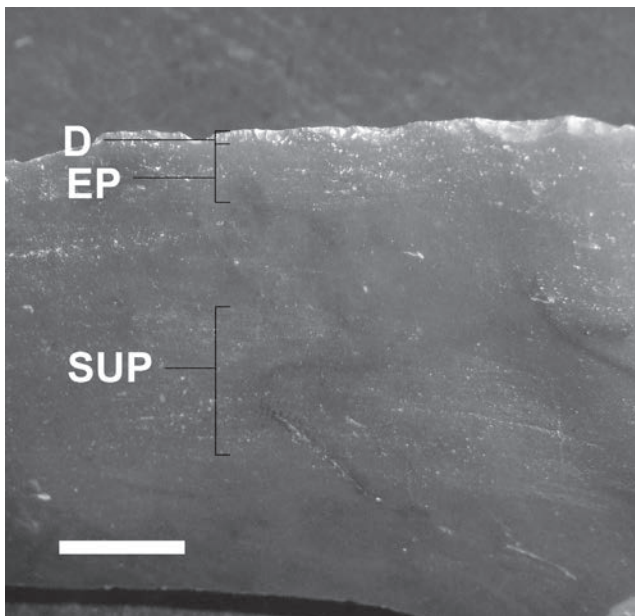


Figure 13.7 Dorsal face of flint flake used to scribe tusk shell beads, showing dulled edge (D), edge polish (EP), and "squaring-up" polish (SUP). Scale: 10 mm.

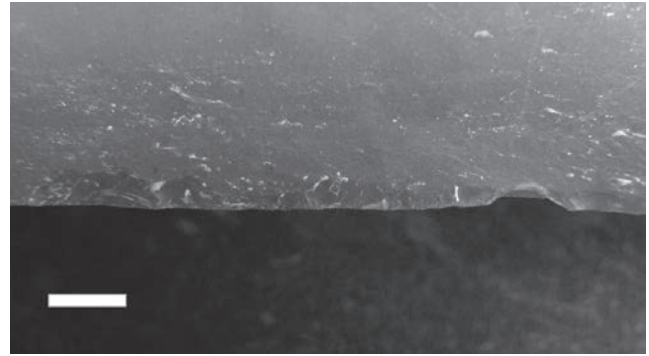


Figure 13.8 Flake edge dulled by scribing tusk shell beads ("D" in Fig. 13.7). Scale: 2 mm.

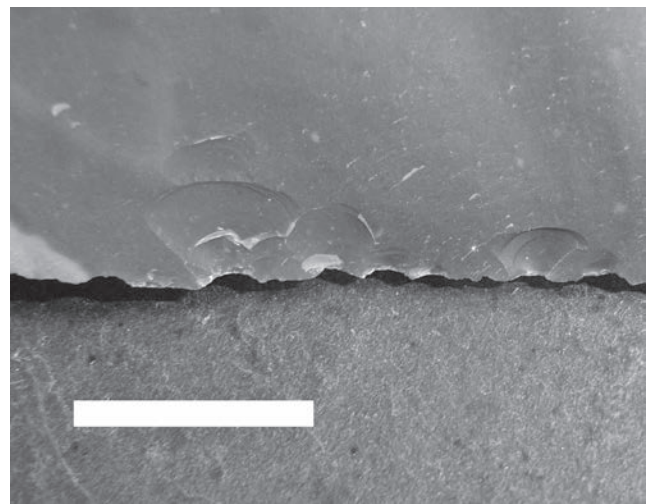


Figure 13.9 Damage to flake edge caused by cleaving tusk shell beads. Scale: 10 mm.

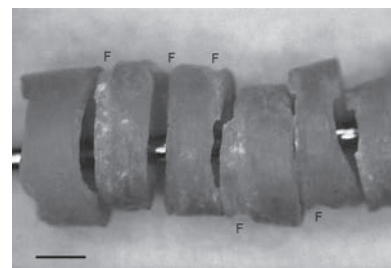


Figure 13.10 Experimental tusk shells made by scribing all-round, showing characteristic steps or flanges ("F"). Scale: 1 mm.

and diameter statistics for the very short Eynan beads are shown in Table 13.1.

The diameter and length of very short Eynan beads (< 2.6 mm long), and beads made by scribing free, are shown in Figure 13.12. The diameters of beads made by scribing did not differ from each other (see above), so the wide range of scribed-free bead diameters was typical. The very short Eynan beads were smaller in average diameter

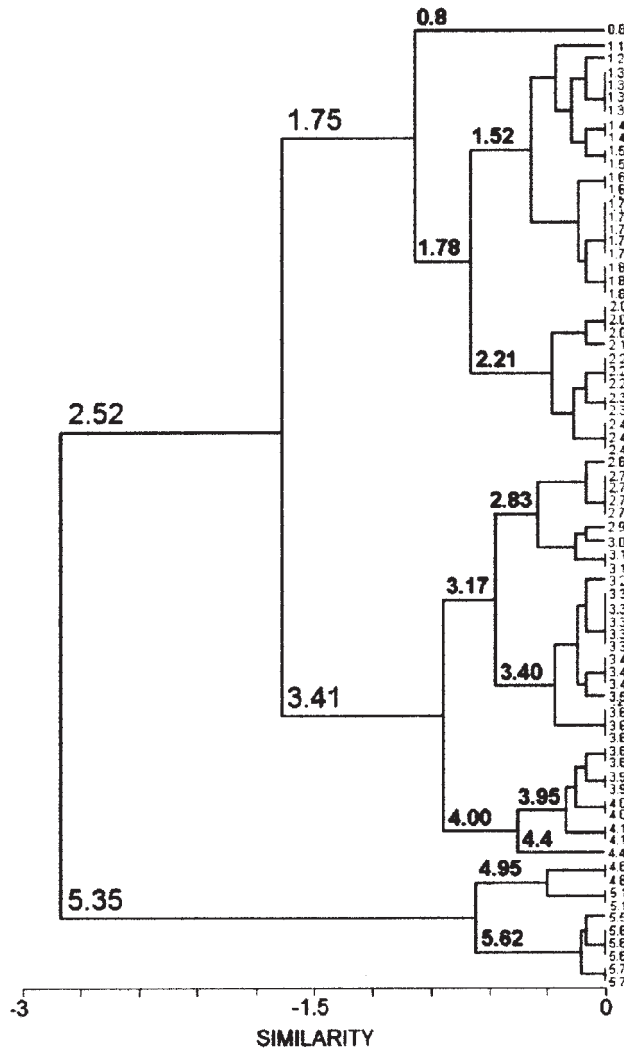


Figure 13.11 UPGMA cluster dendrogram of bead lengths (mm) from Final Natufian Eynan, based on Euclidean distance. Small numbers: bead lengths; large numbers: mean bead length for cluster

than any beads made by scribing and significantly smaller in diameter than the scribed-free beads (Mann-Whitney: $U = 312.5$; $df = 33, 36$; $p = 7.3 \times 10^{-4}$).

Discussion

Gathering

Tusk shells are known from only a few beaches in the region, and even on a beach where they are known, several hours scouring recovered only a few dozen shells. However, an efficient collecting technique (slowly surveying the bands of coarse sand and shell left on the surface by the ebbing tide) developed spontaneously after about an hour's experience, and would have developed equally quickly and easily amongst prehistoric tusk shell collectors. Collecting tusk shells on beaches where they

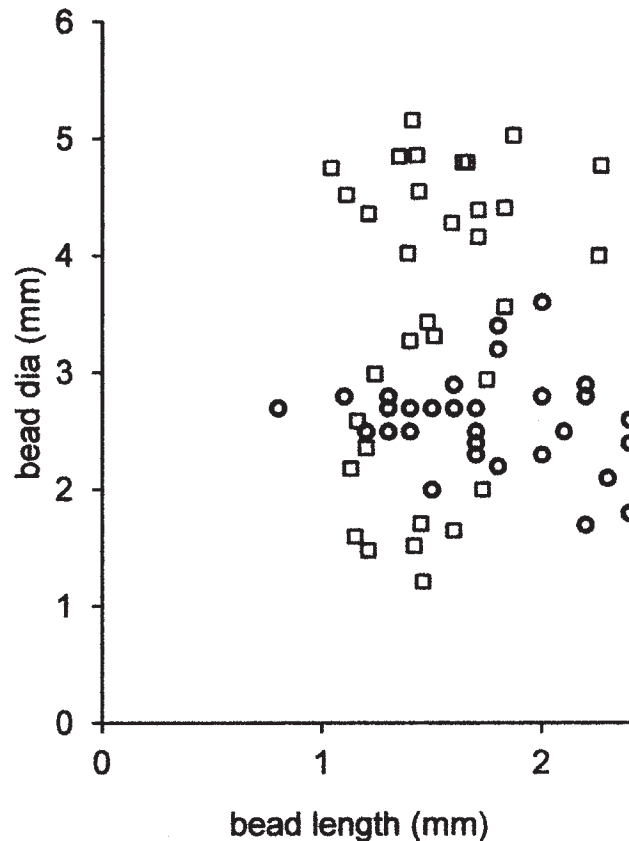


Figure 13.12 Tusk shell bead diameter vs. bead length for beads made by scribing free (squares) and for very short beads (< 2.4 mm) from Final Natufian Eynan (circles).

were known to occur could easily have been combined with forays to the coast for some other activity (such as fishing or shellfish gathering). Collecting could have been carried out by some in the group not so physically suited for the main activity, such as the aged, the infirm, and the young. Prehistoric tusk shell collecting may literally have been "child's play."

Bead-Making Techniques

Reproducing archaeological shell beads with ancient technology has become increasingly common. Such techniques were discussed in eight of 30 papers in the collected proceedings from a recent conference on archaeo-malacology (Álvarez-Fernández and Carvahal-Contreras 2010). Francis (1982, 1986) reviewed the archaeological literature on bead-making techniques. Both Francis (1986:29–30) and Taborin (1993:169–174) identified beads manufactured by a two-step process. Miller (1996) refined the disk-bead-making techniques of Francis (1986) to reproduce the elaborate sequence used to make early Neolithic cockle-shell disk beads at Franchthi Cave, Greece.

In this study, only a fairly small number of beads were made by an inexperienced bead-maker from a small number of shells. It should therefore be thought of as a pilot survey in the sense used by Orton (2000:29). The size distributions of tusk shell beads could be further refined and more accurately compared if larger numbers of beads could have been made by each technique in the study presented here, but the small number of tusk shells that could be gathered prevented this. However, some clear distinctions can be drawn between the different techniques.

Snapping between the fingers and pressing against a flint edge with upper body weight both made beads quickly but were poor for making short beads (< 6 mm long), because such short sections of shell either were strong enough to resist the force applied, or were crushed. Cleaving tusk shells with a flint flake could make short beads, but shattered much of the shell instead of making beads, and would have been abandoned quickly by any bead-maker if tusk shells were in short supply. The other techniques, in which tusk shells were scribed with flint flakes, all made short beads and beads with very similar average lengths. However, scribing and striking tended to crush the shell rather than produce beads, and most beads were scribed free without having to be struck, so this technique would also have been rejected. Scribing in a greenwood chuck produced the shortest bead and the shortest average bead length but rapidly used up flint, and the tendency to crush or snap the bead in the chuck led to a poor yield. This crushing by the chuck affected the larger but thinner-walled anterior end of the shell more than the smaller thicker-walled posterior, which may be why this technique produced beads with the smallest average diameter (although pair-wise differences between techniques in average bead diameter were not statistically significant). Scribing all round took a quite a lot of time and used up a considerable amount of flint flake edge, and tended to produce somewhat longer and more ragged-edged beads. Therefore, scribing beads free seemed the most effective of the techniques attempted, despite the shortest bead made in this way being relatively large.

Natufian Beads, and Comparisons with the Experimental Beads

The visual impression from the histogram supported the results of the cluster analysis that the beads from Final Natufian Eynan consisted of a disparate group of larger beads 7–23 mm long, a few moderately short beads 4.8–5.7 mm long, quite short beads averaging 3.4 ± 0.5 mm long, and a group of very short beads (37% of the assemblage) with a length range of 0.8–2.4 mm and a mean length of 1.8 ± 0.4 mm. Snapping between the fingers or bodyweight pressing almost never made beads less than 3 mm long, so these techniques were unlikely to have been used to make

the very short Eynan beads. The experimental scribing techniques made beads with similar or smaller mean lengths compared to the very short Eynan beads (Tab. 13.1), and the distribution of bead lengths for the very short Eynan beads is very similar to the distributions for beads made by scribing techniques (Fig. 13.5). Therefore, it seems likely that very short beads were made by scribing at Final Natufian Eynan.

All the scribing techniques made beads of 4–5 mm diameter from the larger anterior ends of the tusk shells collected from Knoll Beach (see above), so very short beads with large diameters can be made by scribing. However, very short beads with large diameters were not recovered from Final Natufian Eynan (Fig. 13.12); very short Eynan beads were significantly smaller in diameter. Therefore, very small tusk shell beads at Final Natufian Eynan were not scribed from all parts of the tusk shell, but only from the narrower posterior part. This part is the most difficult to make into small beads by snapping, cleaving or bodyweight pressing, so scribing probably was used to make beads from parts of the tusk shell that were difficult to make into small beads by other means.

Conclusions

Snapping tusk shells by hand and by bodyweight pressing almost never produced beads less than 3 mm long, so very short beads were made by some other technique. Cleaving with a flint flake and scribing and striking wasted much of the tusk shells, so it is unlikely these two techniques were employed. Any of the techniques in which tusk shells were scribed with a flint flake made very small beads. Distinguishing exactly which technique was used to make very short Natufian beads will require evidence of manufacturing techniques on those beads. However, simply gripping the tusk shell with the fingers and scribing it against the edge of a flint flake at one point until a bead breaks free seems to have been the most acceptable means of making very short beads. The very short Natufian beads could have been made easily and simply by carefully using very basic lithic tools.

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